

**Togus Stream Data Report
Summer 2002 Survey
March 2003
DEPLW0584**



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TABLE OF CONTENTS

LOCATION MAPS.....	1
INTRODUCTION	6
STREAMFLOW DATA.....	6
AMBIENT DISSOLVED OXYGEN/TEMPERATURE DATA.....	8
AMBIENT CHEMICAL DATA.....	10
EFFLUENT DATA.....	12
QUALITY CONTROL.....	14
DISCUSSION.....	14
APPENDIX.....	16

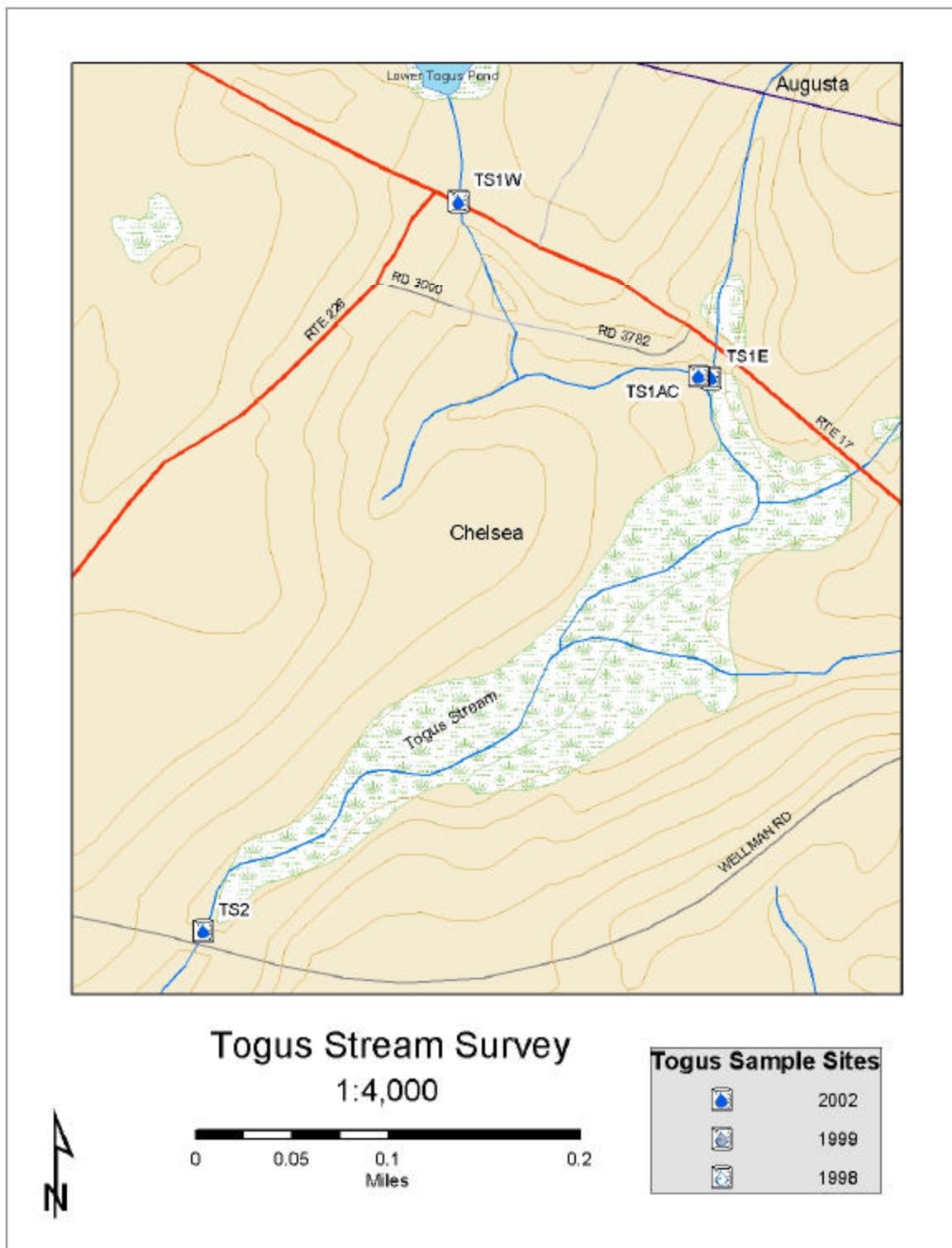
TABLES

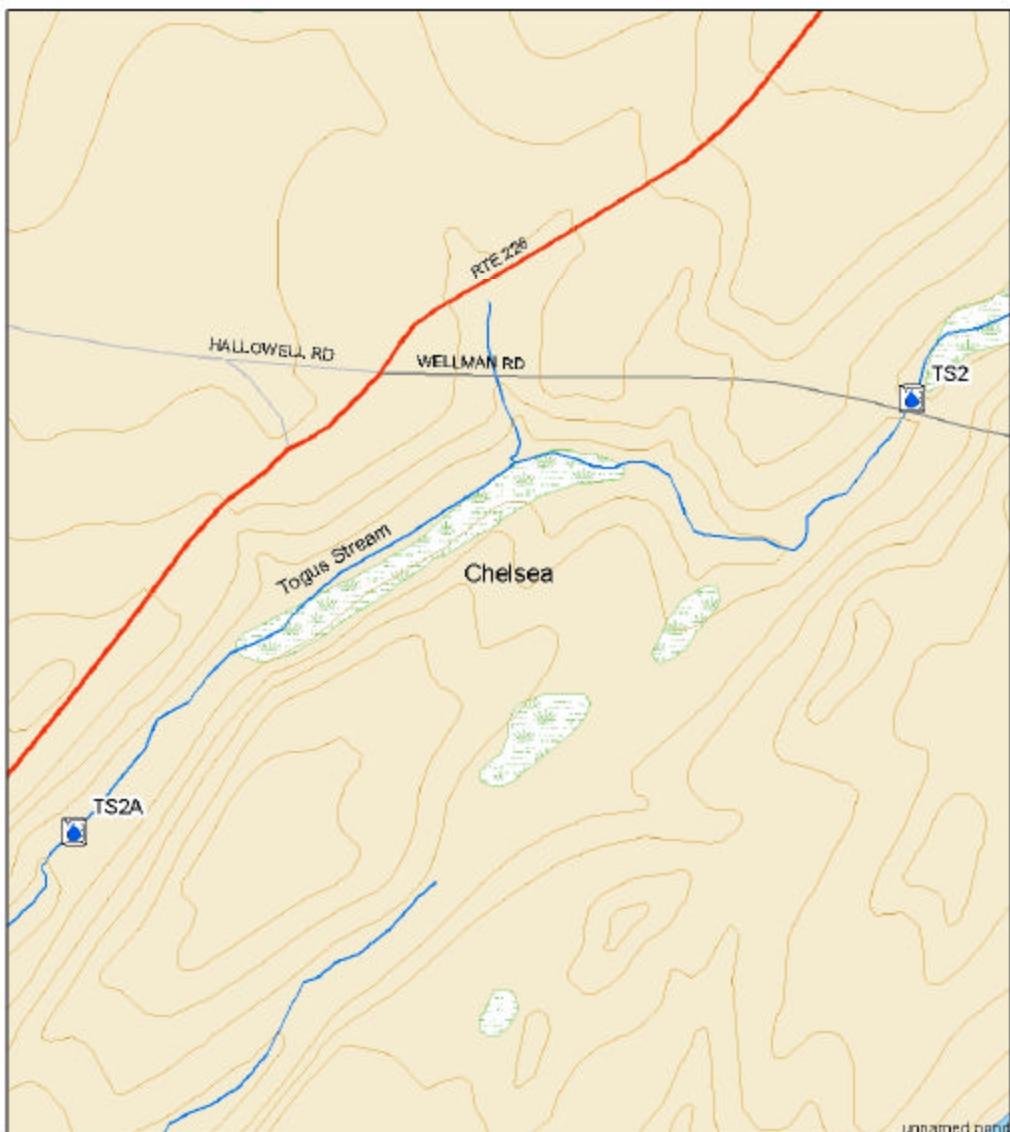
TABLE 1 STREAM FLOW	6
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FIGURES

FIGURE 1 TOGUS STREAM FLOW EXCEEDENCE	7
FIGURE 2 TOGUS STREAM AVERAGE DAILY FLOW, 1981-1995 ...	7
FIGURE 3 GREELY POND OUTLET TEMPERATURE	8
FIGURE 4 TOGUS STREAM TEMPERATURE ABOVE DISCHARGE....	8
FIGURE 5 TOGUS STREAM TEMPERATURE BELOW DISCHARGE....	9
FIGURE 6 TOGUS STREAM TEMPERATURE PINKHAM ROAD	9
FIGURE 7 TOGUS STREAM TEMPERATURE TS2.....	9
FIGURE 8 TOGUS STREAM DO TS2	10
FIGURE 9 2002 TOGUS STREAM DO.....	10
FIGURE 10 2002 TOGUS STREAM TP	11
FIGURE 11 2002 TOGUS STREAM PO4	11
FIGURE 12 2002 TOGUS STREAM NO3	12
FIGURE 13 2002 TOGUS STREAM E. COLI BACTERIA.....	12
FIGURE 14 TOGUS VA DISCHARGE FLOW	13
FIGURE 15 TOGUS VA BOD5 LOADING	13
FIGURE 16 TOGUS VA BACTERIA LOADING	14

Location Maps





Togus Stream Survey

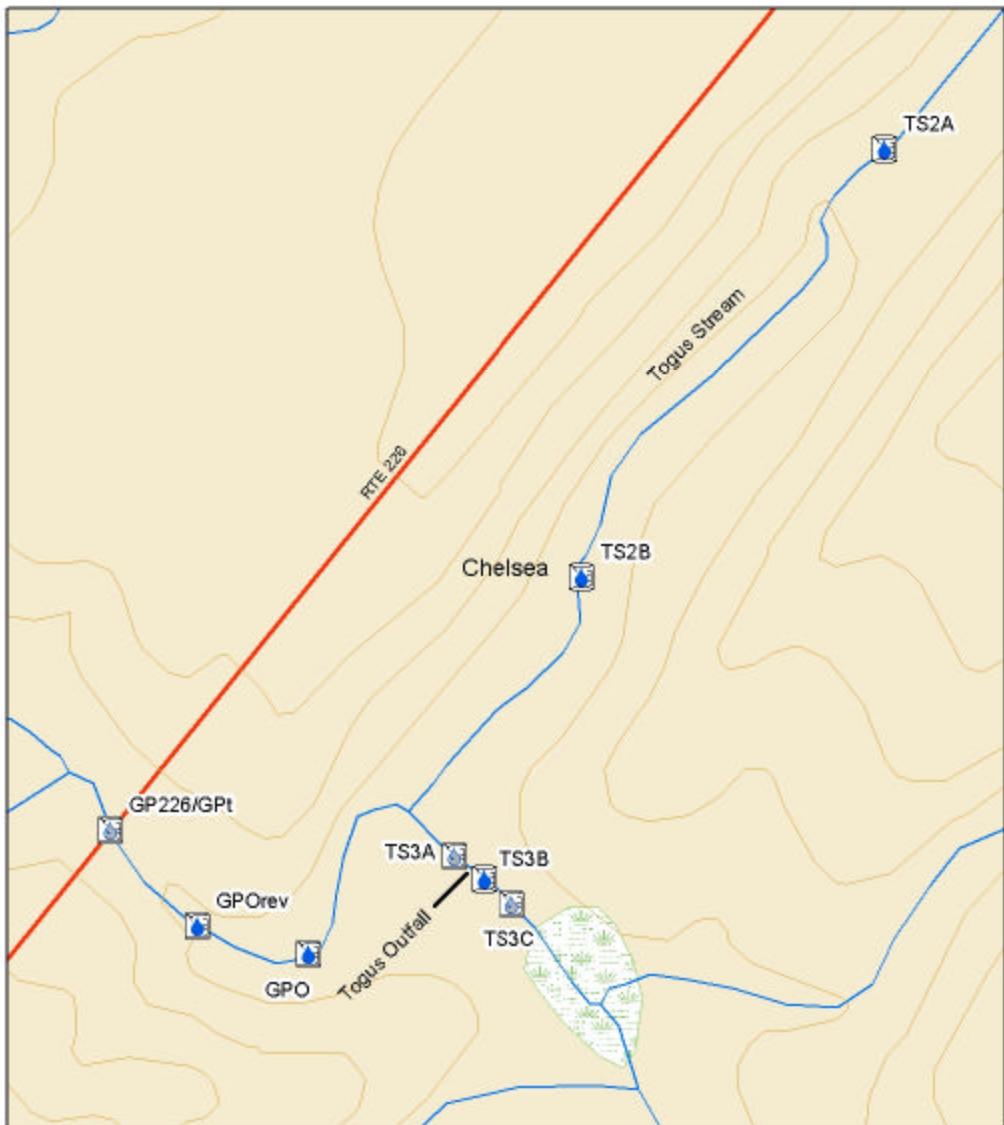
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0 0.05 0.1 0.2
Miles

Togus Sample Sites

	2002
	1999
	1998



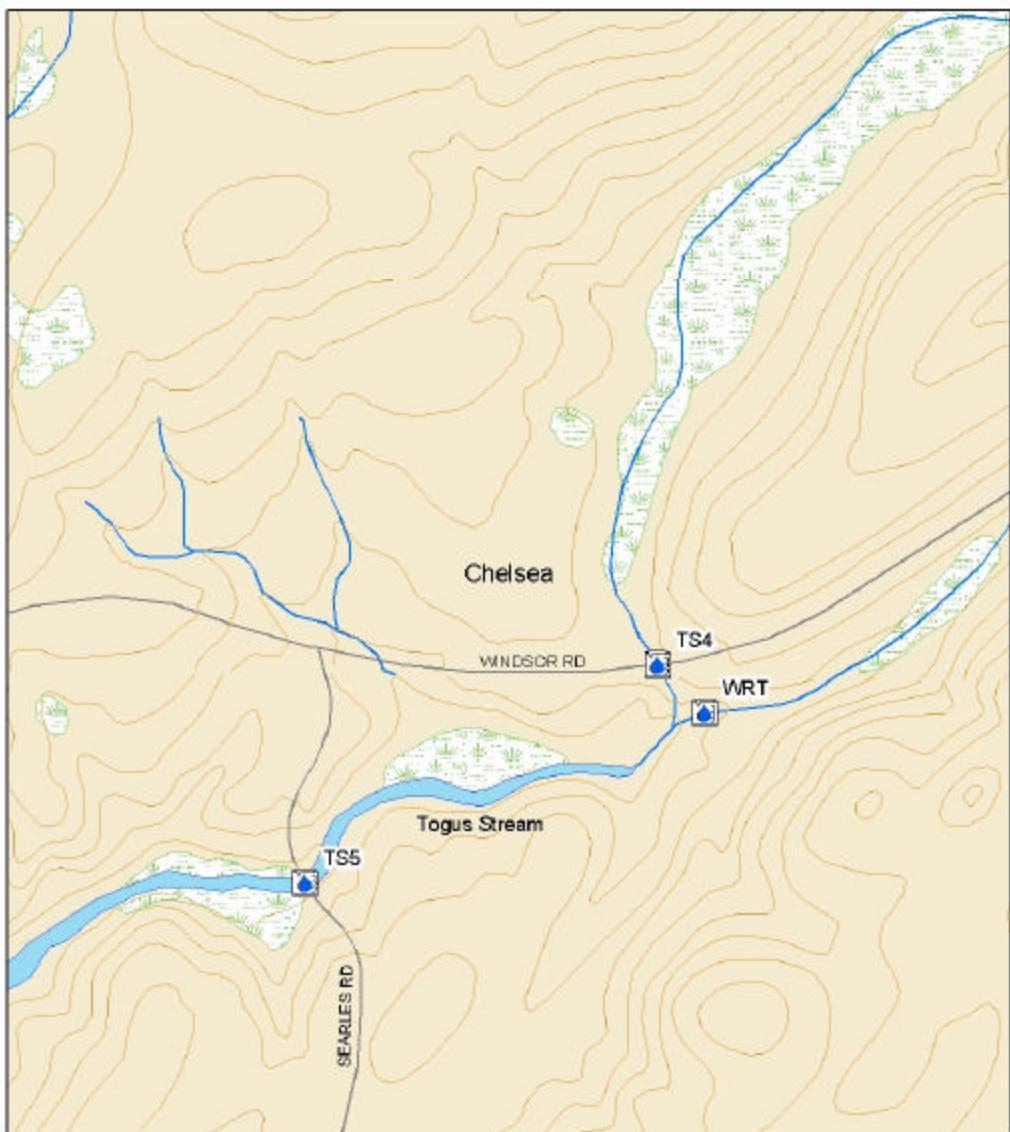
Togus Stream Survey

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Miles

Togus Sample Sites

■	2002
■	1999
■	1998



Togus Stream Survey

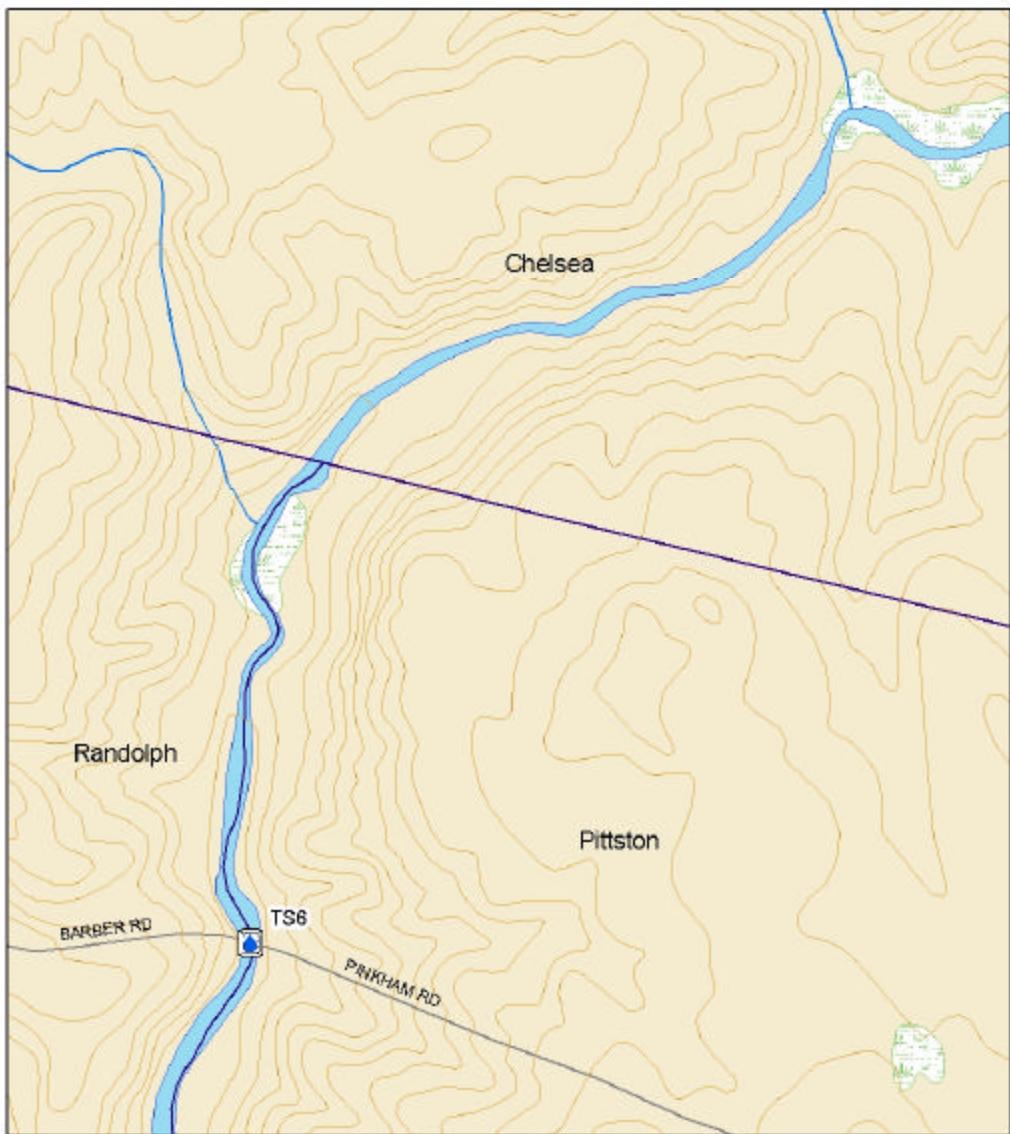
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0 0.05 0.1 0.2
Miles

Togus Sample Sites

	2002
	1999
	1998



Togus Stream Survey
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0 0.05 0.1 0.2
Miles

Togus Sample Sites	
	2002
	1999
	1998

Introduction

Togus Stream forms the outlet of Lower Togus Pond in the towns of Chelsea and Pittston. It extends 7.4 miles from Lower Togus Pond to its confluence with the Kennebec River and has a class B water quality classification for the non-tidal portion. The Togus Veterans Administration discharges treated wastewater (0.23 MGD, permit # ME0000736) to Togus Stream immediately below the confluence with Greely Pond Outlet, approximately 2 miles below Lower Togus Pond. The discharge is located immediately above a concrete overflow weir, which is part of a discontinued USGS flow gaging station. The station is still available for estimating flow provided the weir is clear of obstructions. There is apparently no minimum designated flow at the pond outlet dam. The dam includes a spillway and a pipe (see photos in appendix). Togus and Lower Togus Ponds commonly experience algae blooms. Togus Pond is currently listed on Maine's 303b list of impaired waterbodies for algae blooms. Togus Stream is currently listed for aquatic life due to non-attainment of aquatic life criteria and dissolved oxygen (DO) standards as well as nutrient loading. Monitoring during 1998 and 1999 as well as in previous years has shown DO at levels below classification standards in Togus Stream. As a consequence, TMDLs (total maximum daily load assessments) are required by EPA for the ponds and the stream.

As part of the required TMDL for Togus Stream, a water quality study was initiated during the summer of 2002. The focus of the study was data collection for use in assessing the current impacts on the water quality of the stream and for the completion of the TMDL. This study focused on the river segment between Route 17 and Pinkham Road, a distance of approximately 4.8 miles. The drainage area of Togus Stream at Route 17 is 15.1 mi.² and at the confluence of the Kennebec River is 37.6 mi.². Class B requirements include, among other standards, a minimum DO concentration of 7 ppm or 75% saturation, whichever is greater.

The technical design of the study is described in Togus Stream Work Plan, June 2002. This data report presents the results of this survey.

Streamflow Data

As part of the data collection, river flow measurements were made during each sampling event to establish a flow balance for the study segment. The following table presents the streamflow data.

Table 1 Stream Flow

Site	DA, mi. ²	Flow, cfs (stage, ft.)					
		7/8-9/02	7/17-18/02	7/29-30/02	8/14-15/02	8/26-27/02	9/25/02
Togus Pond West Outlet (culvert)	15.3#	8.8	4.6	1.6	0.8	0.8 **	0.3
Togus Pond East Outlet	15.3#	0.1	0.2	0.1	<.1	-	0.1
Greely Pond Outlet	7.2	-	0.8	0.4	0.1	<.1	0.1
Togus Stream USGS site	23.1	<12.4 (3.185)*	4.8 (3.075)	2.7 (2.94)	1.2 (2.70)	1.2 (2.70)	0.9(2.64)
Togus Stream Windsor Road (culvert)	24.4	-	5.9	2.4	1.0	1.0 **	0.7
Windsor Road Tributary	2.0	-	0.2	0.1	<.1	0.0	0.1

*weir may have been obstructed

**approximate based on depth and previous flow measurements

#two outlets, west outlet is the main outlet

A USGS flow gaging station was in operation near the Togus VA discharge location on Togus Stream from 1981 through 1995. Figure 1 depicts the flow exceedence curve for the period of record and figure 2 depicts the actual daily average flows during the period of record. Flow measured during the survey came close to equaling the lowest flow on record (0.9 cfs vs. 0.85 cfs).

Figure 1 Togus Stream Flow Exceedence

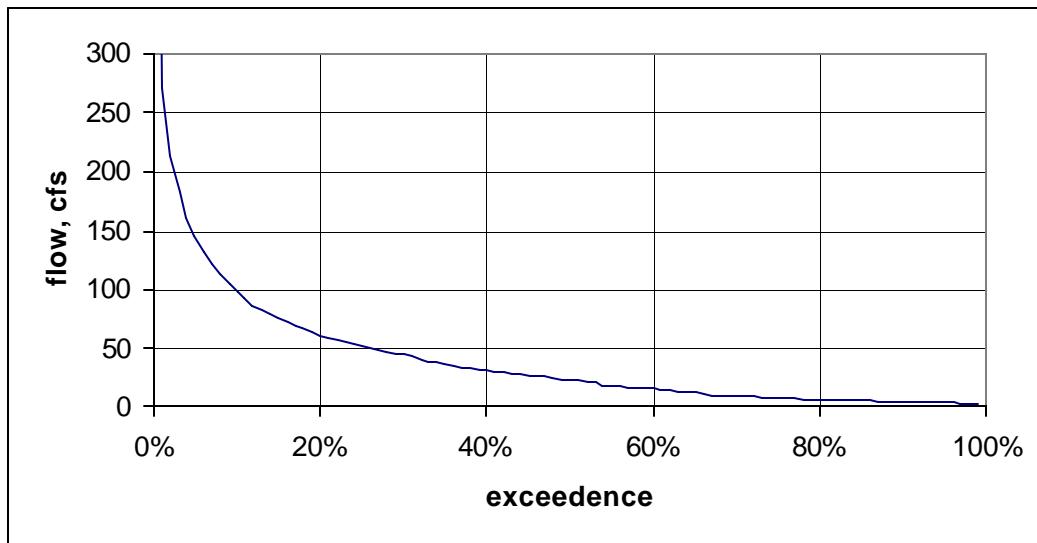
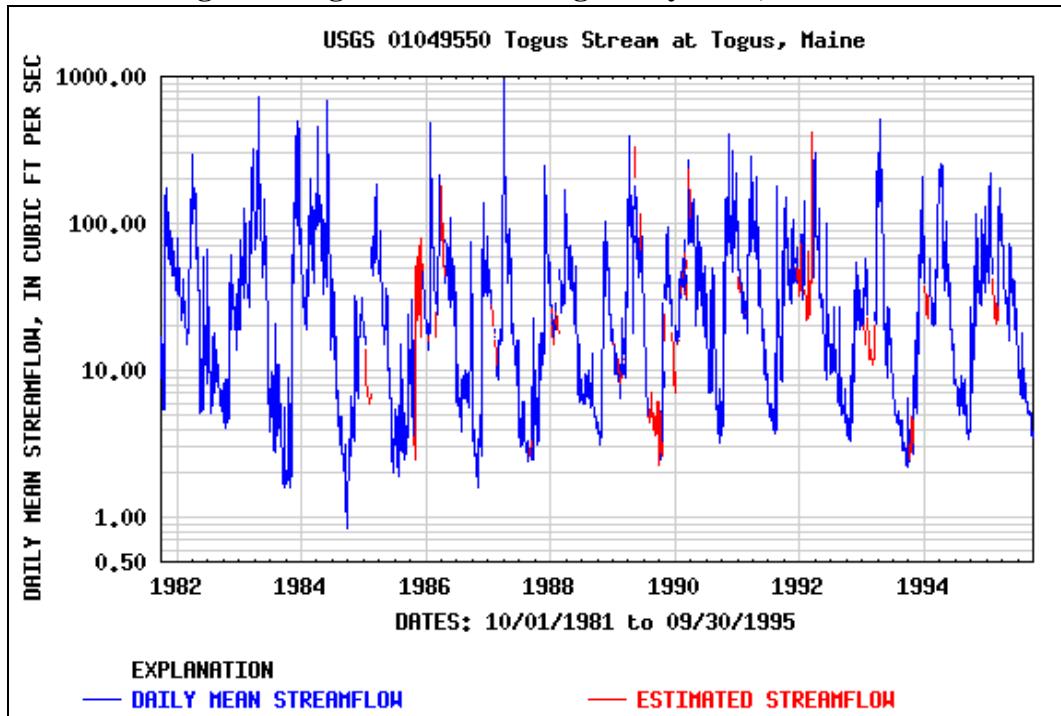


Figure 2 Togus Stream Average Daily Flow, 1981-1995



Ambient Dissolved Oxygen/Temperature Data

As outlined in the work plan, six sampling events (days) were performed during the summer of 2002. Included were measurements of dissolved oxygen (DO) and temperature at a number of selected sites (refer to study location maps) twice each day: early morning and mid afternoon. These data are provided in the appendix (p. A2). Also shown in the appendix are previous years' data at a number of sampling sites. Also during 2002 separate studies were carried out investigating and sampling attached algae (periphyton) and macroinvertebrates (results not yet available). As part of these studies temperature loggers were set out at 4 sites corresponding to sites used in this study. A short-term data sonde was also set out at site TS2, which measured DO and temperature. The following figures show the results of these loggers.

Figure 3 Greely Pond Outlet Temperature

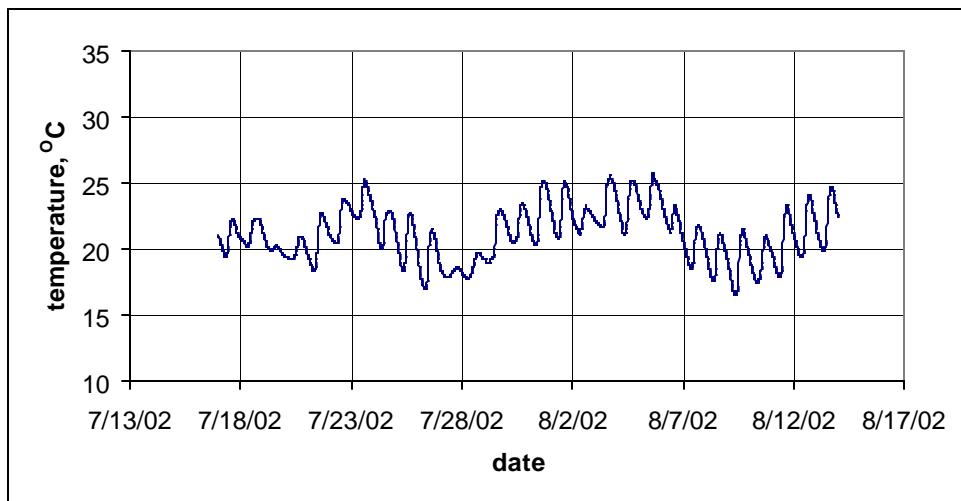


Figure 4 Togus Stream Temperature above discharge

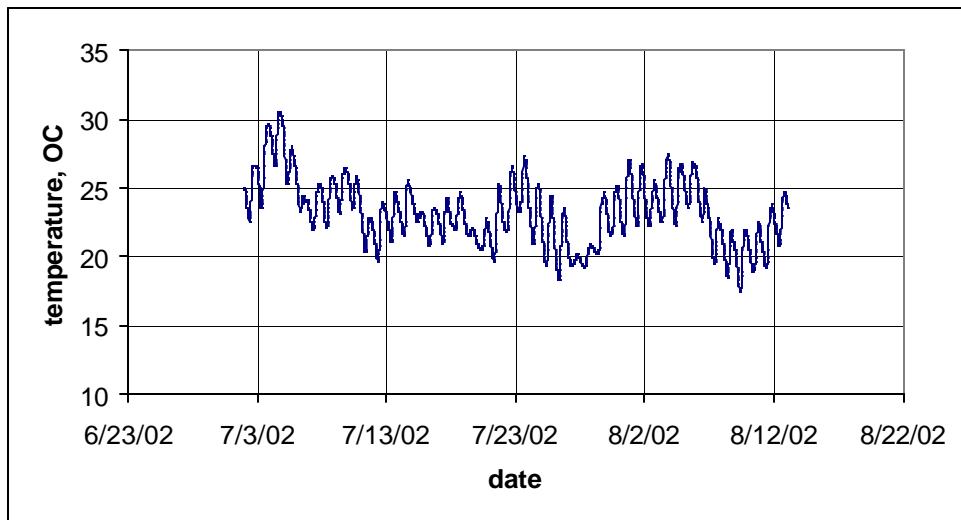


Figure 5 Togus Stream Temperature below discharge

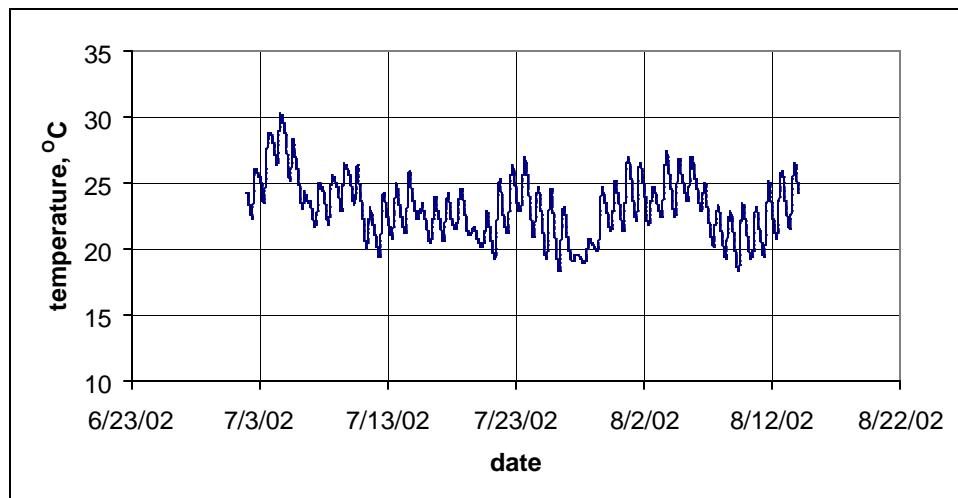


Figure 6 Togus Stream Temperature Pinkham Road

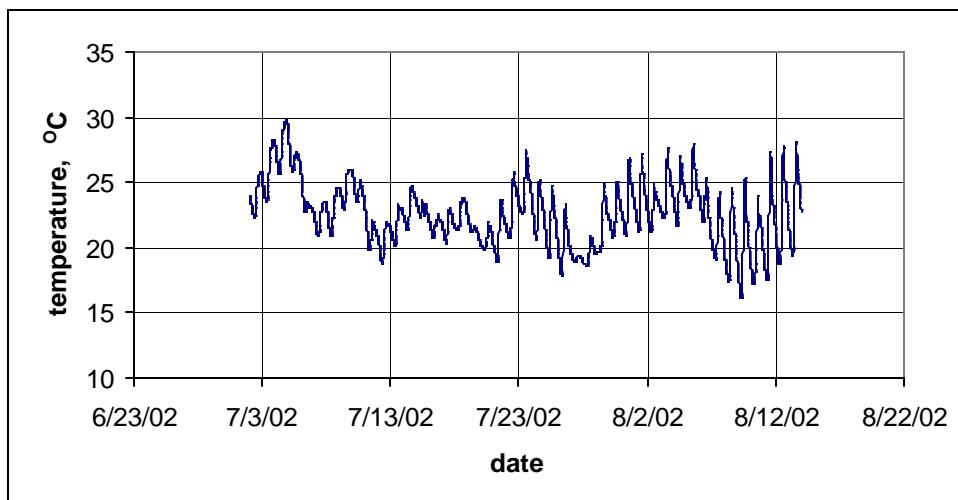


Figure 7 Togus Stream Temperature TS2

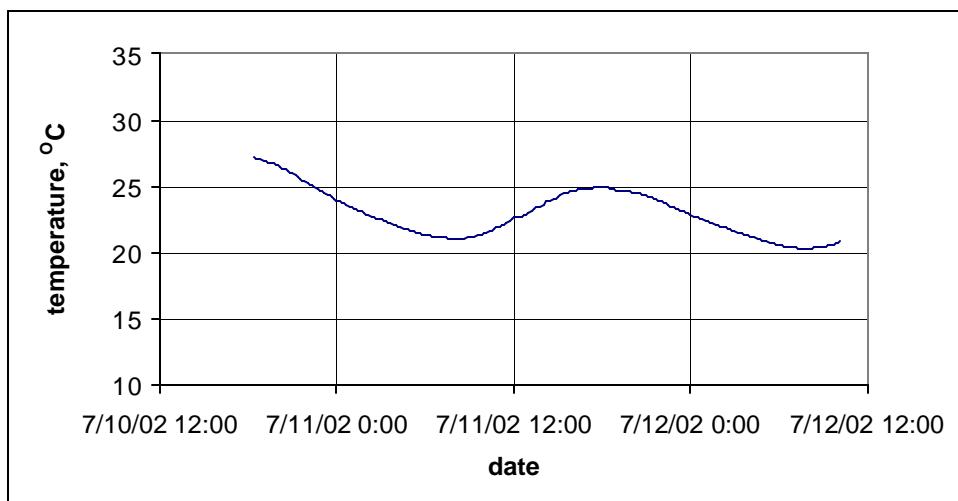


Figure 8 Togus Stream DO TS2

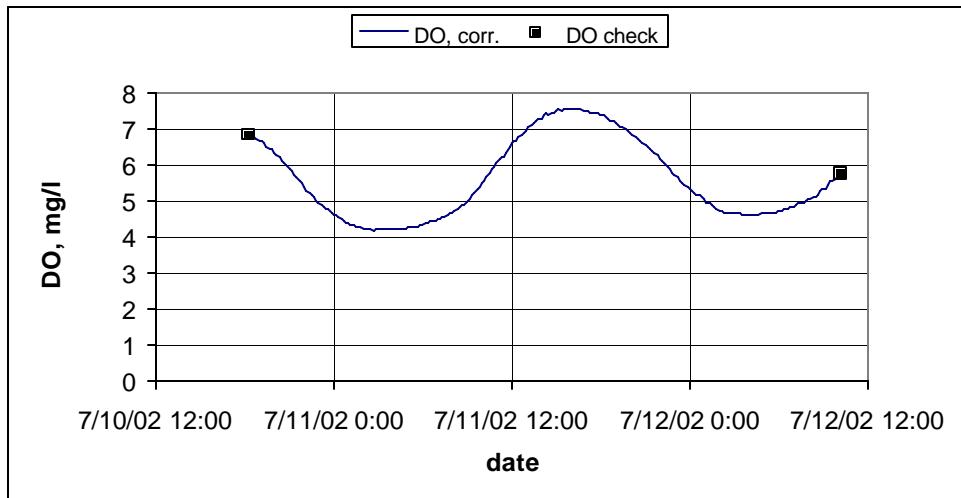
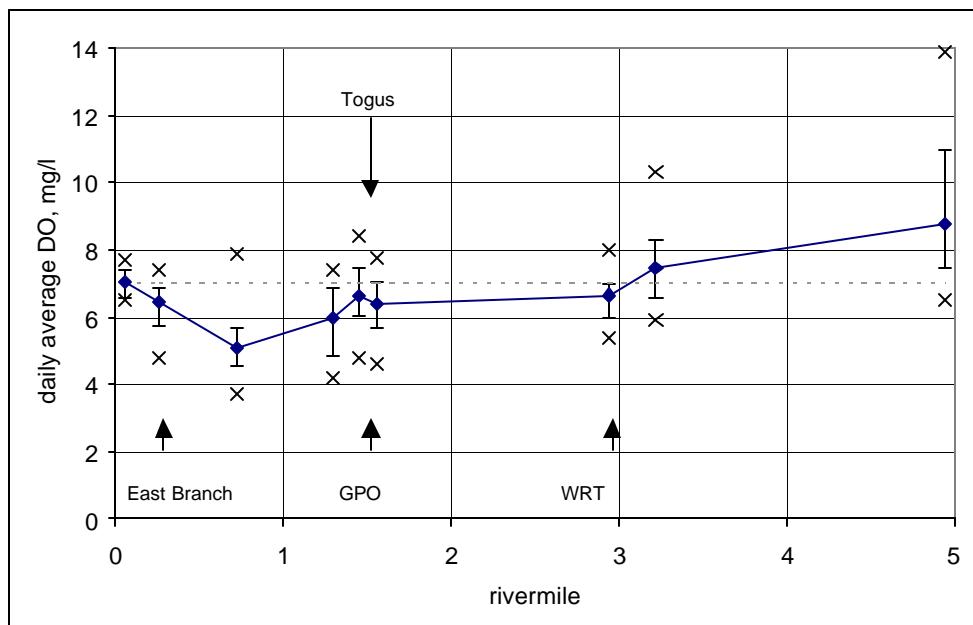


Figure 9 shows the DO data collected during 2002. The dashed line represents the class B DO criteria and the x's represent the minimum and maximum instantaneous measurements.

Figure 9 2002 Togus Stream DO



Ambient Chemical Data

Additional ambient chemical data collected during the 2002 survey included total phosphorous (TP), orthophosphorous (PO₄), total kjeldhal nitrogen (TKN), ammonia nitrogen (NH₃), nitrite plus nitrate nitrogen (NO_x), chlorophyll a (chl-a), ultimate carbonaceous biochemical oxygen demand (CBOD_u) and ultimate nitrogenous biochemical oxygen demand (NBOD_u), pH and E. coli bacteria. These parameters were sampled/measured during the early morning unless

otherwise noted. These data are included on page A8 of the appendix. Chemical data collected for the periphyton studies are given on page A23 of the appendix.

The following figures present selected data results from the 2002 survey:

Figure 10 2002 Togus Stream TP

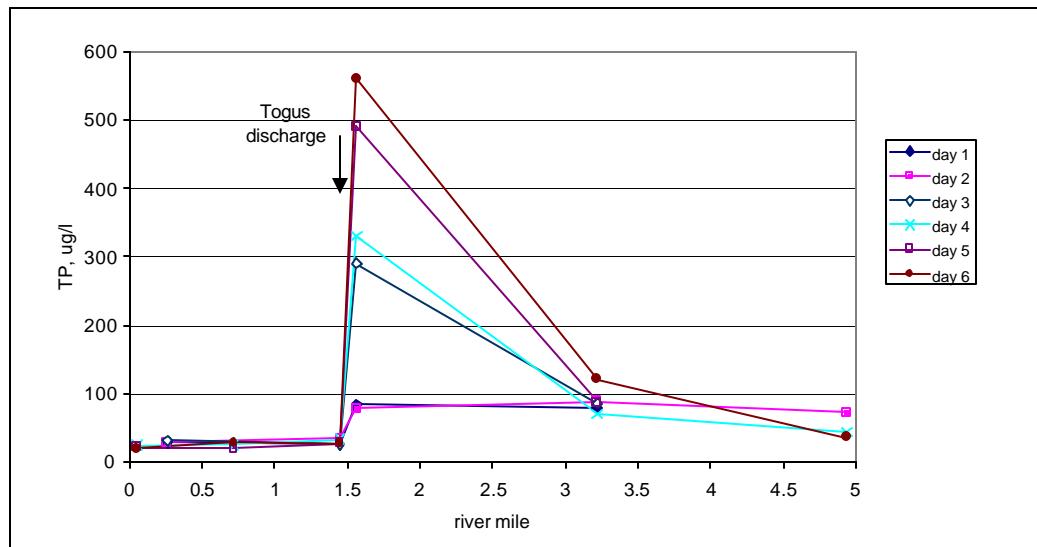


Figure 11 2002 Togus Stream PO4

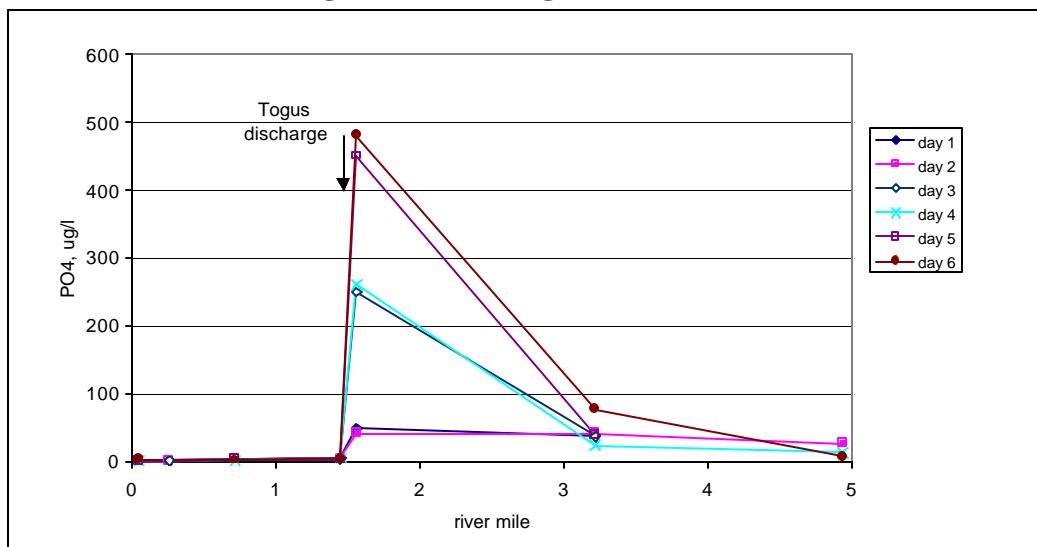


Figure 12 2002 Togus Stream NO3

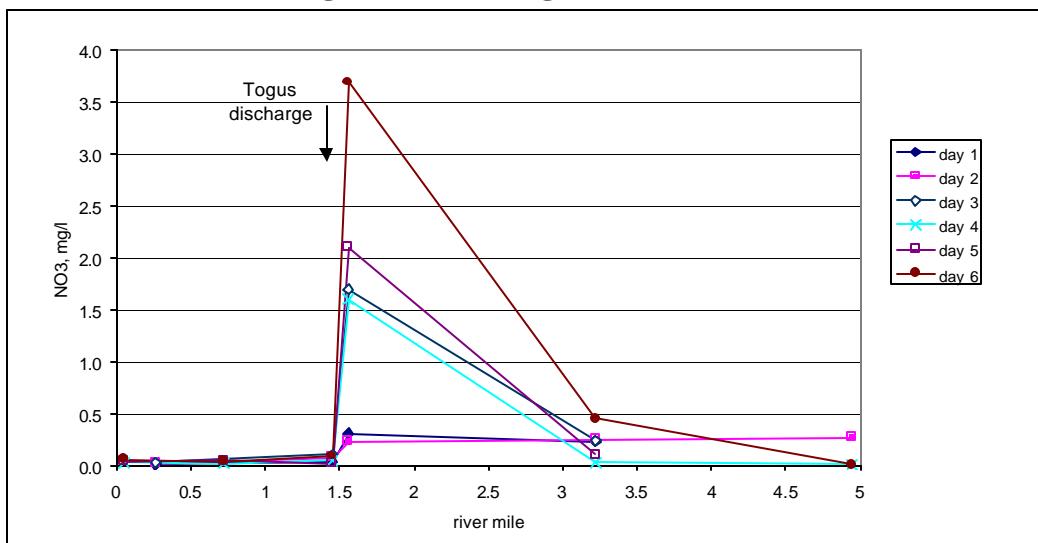
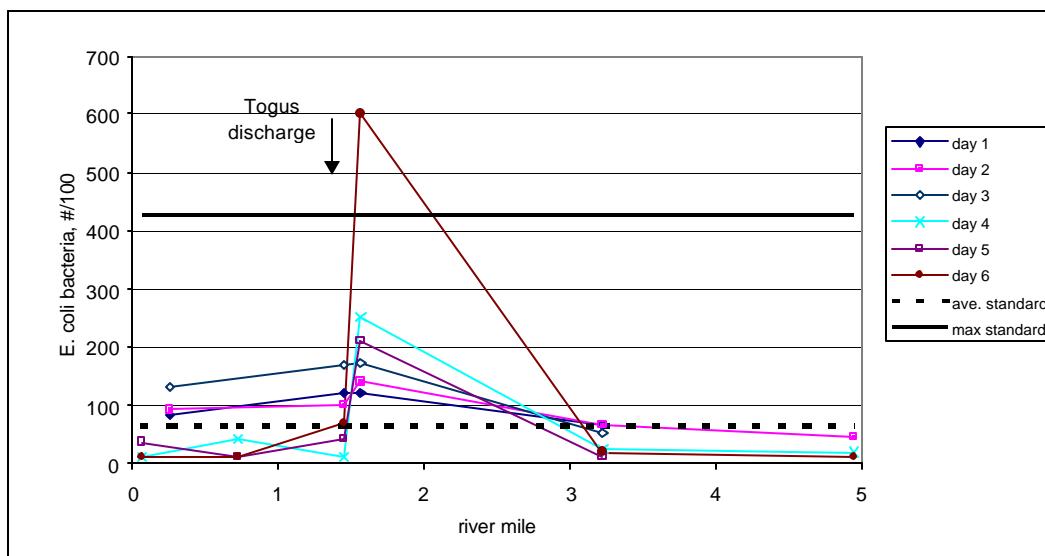


Figure 13 2002 Togus Stream E. coli bacteria



Effluent Data

The Togus VA treatment plant effluent was also sampled during the study for total phosphorous (TP), orthophosphorous (PO₄), total kjeldhal nitrogen (TKN), ammonia nitrogen (NH₃), nitrite plus nitrate nitrogen (NO_x), ultimate carbonaceous biochemical oxygen demand (CBOD_U), ultimate nitrogenous biochemical oxygen demand (NBOD_U) and 5 day biochemical demand (BOD₅). The samples were collected as 24 hour composites. These data are included beginning on page A8 in the appendix.

In general the effluent flow and BOD5 loading were well below permit limits (see following charts).

Figure 14 Togus VA discharge flow

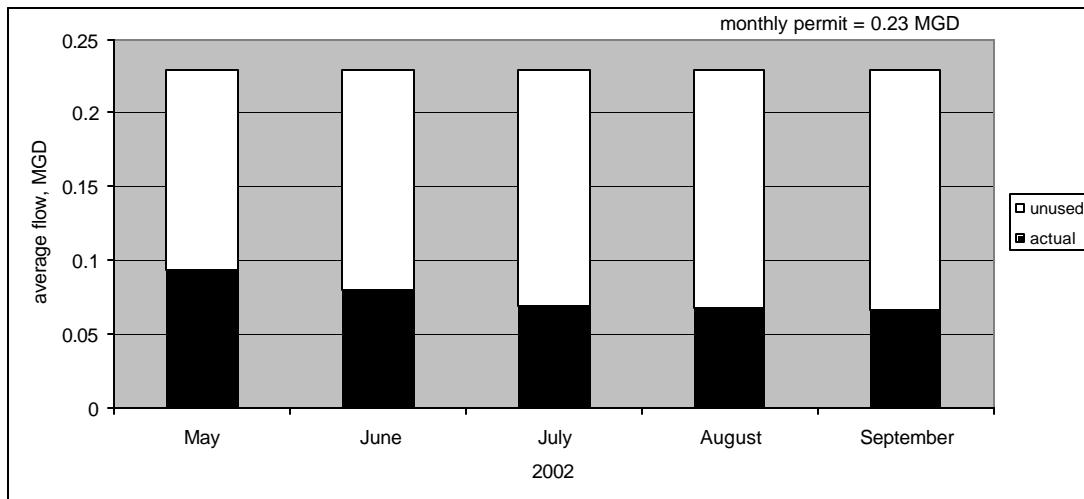


Figure 15 Togus VA BOD5 loading

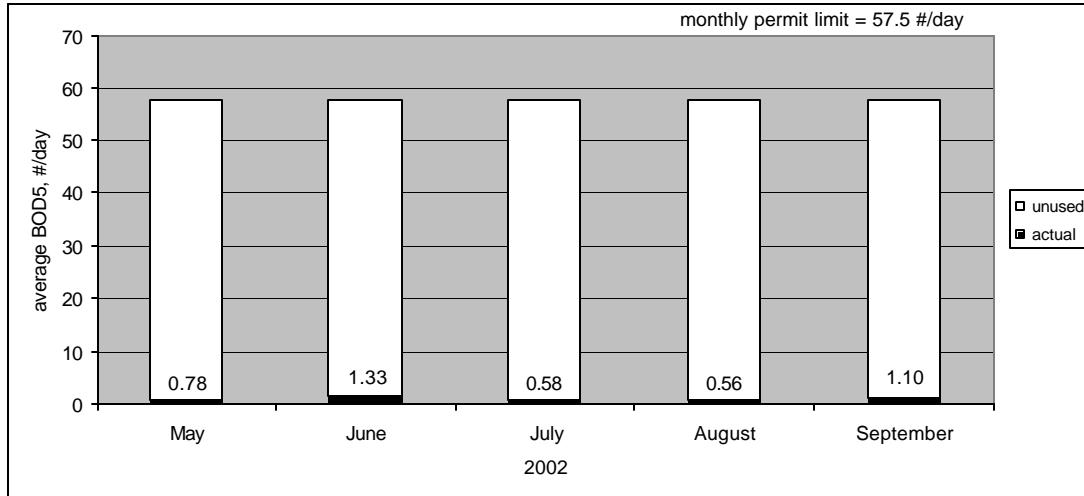
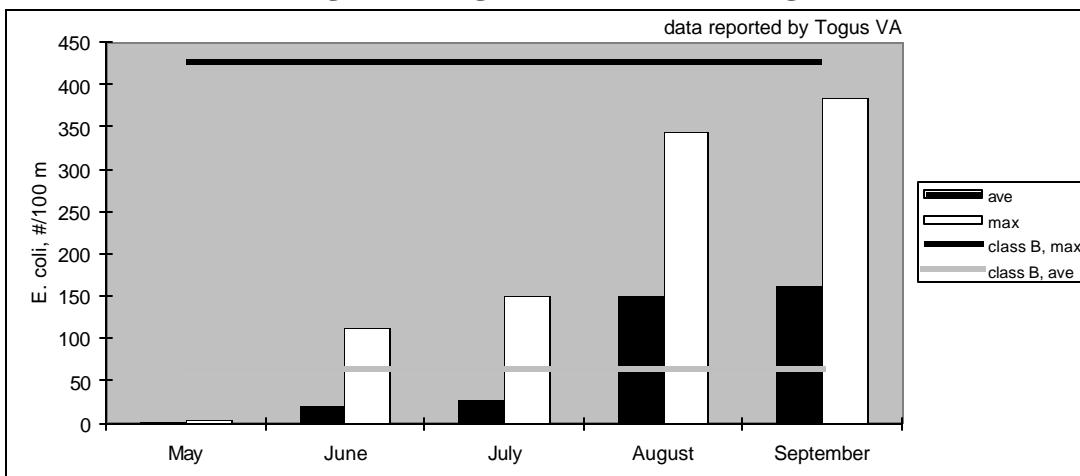


Figure 16 Togus VA bacteria loading



Quality Control

Proper quality control should be followed to assure that all of the data that will be collected are good data. Dissolved oxygen meters were calibrated initially before sampling and checked periodically throughout the day. PH meters were calibrated each day. In addition, the meters of adjacent sampling teams were cross checked both prior to sampling and after completion of sampling to assure the readings from one portion of the river to another are consistent and accurate. The dissolved oxygen readings should agree to within 0.3 ppm and temperatures to within 2° C. The comparisons of the meter cross checks are shown on page A13 of the appendix.

The three-day surveys included ambient and effluent field duplicates. A comparison of the duplicate results is presented in the appendix. In general, the average duplicate variation was within 22% except for bacteria which varied from 33% to 300% (101% average). TBOD, NBOD and CBOD duplicates averaged within 15%. Final NOx averaged within 8% while TKN, NH3, NOx, TP, PO4 and BOD5 averaged within 5%. Lab QA/QC data are available upon request.

Discussion

During 2002 Togus Stream failed to attain class B dissolved oxygen (DO) standards (7.0 ppm/75% saturation) on many occasions both above and below the Togus VA discharge. All morning DO readings were below standard except for those at the uppermost site (lake outlet, TS1W) and the lowermost site (TS6). Afternoon readings were higher but even then a number of sites remained below standard.

There was a consistent, dramatic drop in DO concentration between the main lake outlet (dam) and site TS2 (Wellman Rd.). The secondary outlet (TS1E) was also consistently very low in DO concentration. From site TS2 to the end of the study reach there was in general a steady recovery in DO concentration. Both sites TS2 and TS1E are located at the outlet of marshy, wetland areas.

In general instream BOD, both above and below the discharge, was greater than typical ambient concentrations, except for possibly the last sample event (day 6). The effluent quality in terms of DO, temperature and BOD was consistently equal to or better than the receiving water.

The major impact of the Togus VA discharge was in terms of nutrient loading, specifically TP, PO₄ and NO₃ (refer to figures 10 through 12). The instream concentrations of these nutrients decreased downstream of the discharge but remained at elevated levels even at the last study site (TS6). Since there is little increase in stream flow below the discharge these nutrients are either being taken up by plants or settling. There were some indications of increased plant growth below the outfall, such as increased diurnal DO swings, but the impact was not excessive as indicated by early morning DO readings at the lower sites. Colored water and shading may be helping to mitigate the high nutrient loading. Phytoplanton (floating algae) concentrations were generally low as indicated by chl-a sample results; therefore any nutrient impacts are probably in terms of bottom attached algae and macrophytes.

The data also indicate a bacteria impact from the discharge (see figure 13). On one occasion the instream bacteria at the site below the discharge was increased to above the maximum class B standard. Bacteria as measured after disinfection at the treatment plant increased throughout the summer but did not exceed the maximum instream standard. It is possible that some re-growth of bacteria is occurring within the long outfall pipe between the point where disinfection is performed at the treatment plant and the point of discharge to the stream.

Togus Stream is scheduled for completion of an EPA-required TMDL (total maximum daily load analysis) by 2004. A watershed survey of Togus Pond and Togus Stream is planned for the summer of 2003 (by Kennebec County Soil and Water Conservation District), the results of which could be useful in the development of the TMDL. It is anticipated that a draft TMDL will be completed this year (2003).

Appendix

DO AND TEMPERATURE DATA 1986-1999.....	A1
DO AND TEMPERATURE DATA 2002.....	A2
CHEMICAL DATA.....	A8
2002 SURVEY WEATHER CONDITIONS.....	A12
METER CROSS CHECKS, 2002 TOGUS STREAM SURVEY.....	A13
FIELD DUPLICATE SAMPLE COMPARISONS.....	A15
TOGUS STREAM PERiphyton STUDY 2002	A23
PHOTOGRAPHS (9/26/02)	A24

DO and Temperature Data 1986-1999

7/28/1999						8/12/1999						9/2/1998						8/28/1998					
Site	Time	Depth	DO	Temp		Time	Depth	DO	Temp		Time	Depth	DO	Temp		Time	Depth	DO	Temp				
TS1E	6:50	mid depth	2.9	19.0		6:40	mid depth	3.7	17.7		8:20	mid depth	2.3	18.6		-	-	-	-				
Rt. 17, east bridge	14:23	mid depth	4.4	25.7		13:38	mid depth	4.6	21.2		13:42	mid depth	2.2	18		-	-	-	-				
TS1W	6:54	mid depth*	6.6	23.0		6:45	mid depth*	7.3	20.0		6:25	mid depth	7.2	21.8		6:18	mid depth	7.2	23				
Rt. 17, west bridge	14:27	mid depth*	7.55	28.1		13:42	mid depth*	7.9	22.7		13:35	mid depth	8	23.2		13:15	mid depth	7.4	26				
TS2	-	-	-	-		-	-	-	-		6:35	mid depth	5.3	20		6:30	mid depth	5	22				
Wellman Rd.	-	-	-	-		-	-	-	-		13:27	mid depth	6.6	21.2		13:25	mid depth	6.6	24.2				
TS2A	7:10	mid depth	4.1	22.3		7:00	mid depth	5.1	19.8		-	-	-	-		-	-	-					
Cemetery	14:37	mid depth	6.2	26.3		13:25	mid depth	5.7	21.0		-	-	-	-		-	-	-					
GPtogus	-	-	-	-		-	-	-	-		6:40	mid depth	5.2	17.7		6:40	mid depth	3.7	20.3				
Greely Pond Outlet (Togus)	-	-	-	-		-	-	-	-		13:17	mid depth	6.4	19.7		13:32	mid depth	4.3	21.8				
GP26	7:29	mid depth	4.2	19.6		7:13	mid depth	5.4	18.2		-	-	-	-		-	-	-					
Greely Pond Outlet (Rt. 226)	PM	mid depth	7	25		13:14	mid depth	6.9	21.0		-	-	-	-		-	-	-					
Above outfall	-	-	-	-		-	-	-	-		7:18	0	5.7	18.9		7:00	0	5.2	21				
-	-	-	-	-		-	-	-	-		1	5.7	18.9		-	-	-	-					
-	-	-	-	-		-	-	-	-		2	5.6	18.9		-	-	-	-					
TS3A	-	-	-	-		-	-	-	-		14:20	mid depth	9.2	21.2		13:45	mid depth	8.5	24.2				
Above Weir	-	-	-	-		-	-	-	-		6:40	mid depth	5.2	19		6:53	mid depth	4.8	21				
TS3B	-	-	-	-		-	-	-	-		-	mid depth	8.8	21		13:40	mid depth	9	24.2				
Below Weir	-	-	-	-		-	-	-	-		6:42	mid depth	5.8	19		6:55	mid depth	5.6	21				
-	-	-	-	-		-	-	-	-		13:58	mid depth	8.9	21		13:42	mid depth	8.3	24				
Beginning of pool	-	-	-	-		-	-	-	-		7:12	mid depth	6.35	19		-	-	-	-				
-	-	-	-	-		-	-	-	-		14:08	mid depth	9	21.1		-	-	-	-				
TS3C	7:50	0	4.5	22.8		AM	0	5.45	19.8		7:05	0	5.9	19.3		-	-	-	-				
End of Pool		1	2.5	22		1	4.8	18.8			1	5.9	19.3		-	-	-	-					
		below beaver dam	5.5	22.7		12:50	0	6.0	21.6		2	5.9	19.2		-	-	-	-					
						7:37	below beaver dam	6.2	19.8		14:12	0	8.4	21.1		-	-	-	-				
						12:36	below beaver dam	6.15	21.0		1	8.1	20.5		-	-	-	-					
						8:10	mid depth	5.35	18.1		2	6.9	19.5		-	-	-	-					
TS4	8:23	mid depth	4.65	22		12:06	mid depth	6.3	19.7		-	mid depth	-	-		-	-	-	-				
Windsor Rd.	15:00	mid depth	4.9	24.6		8:22	mid depth	7.2	18.0		7:43	mid depth	7.6	18.8		7:17	mid depth	7	20.8				
TS5	8:40	mid depth	6.7	21.3		12:20	mid depth	8.4	20.0		14:40	mid depth	9.2	22		13:57	mid depth	8.5	24.9				
Searls Mills Rd.	15:08	mid depth	7.5	26.9		-	-	-	-		7:56	mid depth	8.95	17.9		7:30	mid depth	7.9	20				
TS6	-	-	-	-		-	-	-	-		14:50	mid depth	9.75	22		14:12	mid depth	9.5	25.2				
Barber/Pinkham Rd.	-	-	-	-		-	-	-	-		8:05	mid depth	3.3	17.7		7:45	mid depth	3.4	19.8				
SMt	-	-	-	-		-	-	-	-		15:05	mid depth	3.8	19		14:17	mid depth	3.6	22				
Stoney Meadow Brook	-	-	-	-		-	-	-	-		-	-	-	-	-	-	-	-					

*above confluence w/ E branch

*above confluence w/ E branch

8/14/1998						8/16/1991						7/17/1986									
Site	Time	Depth	DO	Temp		Time	Depth	DO	Temp		Time	Depth	DO	Temp		Time	Depth	DO	Temp		
TS1E	-	-	-	-		8:40	mid depth	4.6	19.9		-	-	-	-		-	-	-	-		
Rt. 17, east bridge	-	-	-	-		-	-	-	-		7:35	mid depth	7.8	23		15:45	mid depth	7.4	22.8		
TS1W	9:35	mid depth	7.6	21.7		-	-	-	-		7:45	mid depth	4.2	22.2		-	-	-	-		
Rt. 17, west bridge	13:15	mid depth	7.5	23.9		-	-	-	-		9:40	mid depth	4.2	22.5		-	-	-	-		
TS2	6:56	mid depth	5.4	19.8		7:50	mid depth	6	20		-	-	-	-		-	-	-	-		
Wellman Rd.	13:27	mid depth	6.8	22.9		-	-	-	-		-	-	-	-		-	-	-	-		
TS2A	-	-	-	-		-	-	-	-		-	-	-	-		-	-	-			
Cemetery	-	-	-	-		-	-	-	-		-	-	-	-		-	-	-			
GPtogus	7:30	mid depth	4.5	17.1		-	-	-	-		-	-	-	-		-	-	-			
Greely Pond Outlet (Togus)	13:35	mid depth	6.1	20.2		-	-	-	-		-	-	-	-		-	-	-			
GP26	-	-	-	-		7:50	mid depth	6	20		-	-	-	-		-	-	-			
Greely Pond Outlet (Rt. 226)	-	-	-	-		-	-	-	-		-	-	-	-		-	-	-			
Above outfall	-	-	-	-		-	-	-	-		-	-	-	-		-	-	-			
-	-	-	-	-		-	-	-	-		-	-	-	-		-	-	-			
TS3A	9:10	mid depth	6.4	19		-	-	-	-		-	-	-	-		-	-	-			
Above Weir	13:45	mid depth	7.8	21.9		-	-	-	-		-	-	-	-		-	-	-			
TS3B	9:12	mid depth	6.8	19		-	-	-	-		-	-	-	-		-	-	-			
Below Weir	13:46	mid depth	8	21.9		-	-	-	-		-	-	-	-		-	-	-			
Beginning of pool	-	-	-	-		-	-	-	-		-	-	-	-		-	-	-			
TS3C	-	-	-	-		-	-	-	-		-	-	-	-		-	-	-			
End of Pool	-	-	-	-		-	-	-	-		-	-	-	-		-	-	-			
TS4	8:10	mid depth	7.1	19.1		-	-	-	-		8:05	mid depth	6.4	22		15:57	mid depth	6.7	22		
Windsor Rd.	14:10	mid depth	7.6	22		-	-	-	-		-	-	-	-		-	-	-			
TS5	8:20	mid depth	8	18.5		-	-	-	-		-	-	-	-		-	-	-			
Searls Mills Rd.	14:00	mid depth	8.5	22.8		-	-	-	-		-	-	-	-		-	-	-			
TS6	8:32	mid depth	9	18.5		-	-	-	-		8:20	mid depth	8	21.2		16:05	mid depth	9.5	23.9		
Barber/Pinkham Rd.	14:24	mid depth	9	23.2		-	-	-	-		-	-	-	-		-	-	-			
SMt	8:45	mid depth	3.2	17.7		-	-	-	-		-	-	-	-		-	-	-			
Stoney Meadow Brook	14:30	mid depth	4	20.8		-	-	-	-		-	-	-	-		-	-	-			

DO and Temperature Data 2002

Date:	07/09/02				
Station		pH	DO mg/l	Temp °C	% Sat
TS1AC	05:55	6.4	6.7	23.7	79%
	13:50	6.5	7.3	25.5	90%
TS1E	05:45	6.2	4.2	19.7	46%
	13:46	6.5	6.6	24.3	79%
TS2	06:13	6.3	4.6	23.3	54%
	14:00	6.6	7.9	25.6	96%
TS2B	06:33	6.4	6.2	23.4	73%
	14:11	6.6	7.1	26.0	88%
TS3B	06:50	6.5	6.3	23.2	74%
	14:25	6.7	7.5	25.9	92%
TS4	07:35	6.6	5.9	23.4	69%
	15:02	6.6	6.9	26.0	85%
TS5	07:53	6.7	6.5	23.2	76%
	15:15	6.8	7.0	26.3	87%
TS6	08:22	6.8	7.2	22.8	84%
	15:29	7.0	7.9	26.1	98%
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GPO	7:02	6.8	6.8	21.8	77%
	14:33	6.9	7.4	24.6	88%
WRT	07:25	6.7	6.5	19.9	71%
	14:56	6.7	6.1	23.7	72%
TVA	07:10	-	8.1	21.1	91%
	14:46	-	7.9	21.5	90%

all samples at mid depth

Date:	07/18/02				
Station		pH	DO mg/l	Temp °C	% Sat
TS1AC	06:00	6.5	6.8	21.4	76%
	15:15	6.6	7.0	25.5	85%
TS1E	05:50	6.15	4.1	17.7	43%
	15:10	6.5	6.6	23.0	77%
TS2	06:15	6.3	4.2	21.8	48%
	15:35	6.6	7.1	24.9	86%
TS2A cem.	06:30	-	5.9	22.3	68%
	15:05	-	7.4	24.4	89%
TS2B	06:40	6.4	6.25	22.0	71%
	14:45	6.9	7.3	24.6	88%
TS3B	07:00	6.5	6.4	21.5	73%
	14:15	7.0	7.75	24.1	92%
TS4	06:50	6.7	6.7	21.7	76%
	15:05	6.95	7.1	24.4	85%
TS5	06:35	6.9	7.0	21.3	79%
	14:40	7.2	7.6	24.5	91%
TS6	06:00	7.1	7.4	21.2	83%
	14:25	7.5	8.6	23.6	101%
<hr/>					
GPO	7:20	6.9	7.1	20.1	78%
	14:25	7.1	7.5	22.6	87%
WRT	07:05	6.8	7.4	18.1	78%
	14:55	6.9	6.8	21.4	77%
TVA	07:35	-	7.6	21.4	86%
	14:40	-	7.8	21.5	88%

all samples at mid depth

Date:	07/30/02				
Station		pH	DO mg/l	Temp °C	% Sat
TS1W	06:40	-	7.1	22.4	82%
	14:05	-	7.3	24.8	88%
TS1AC	06:15	6.3	6.2	21.8	71%
	14:20	6.7	7.3	24.7	88%
TS1E	06:00	6.0	3.4	18.9	36%
	14:15	6.5	5.4	22.8	63%
TS2	06:30	6.1	4.3	23.0	50%
	14:30	6.6	5.7	24.6	68%
TS2A cem.	06:50	-	5.5	21.7	63%
	14:45	-	7.0	24.1	83%
TS2B	07:00	6.4	5.8	21.5	66%
	14:50	6.9	7.6	24.8	92%
TS3B	07:30	6.6	5.8	21.3	65%
	15:00	7.0	7.6	23.9	90%
TS4	06:45	6.75	6.4	21.4	72%
	14:40	6.9	7.6	24.5	91%
TS5	06:30	6.9	6.6	21.1	74%
	14:30	7.1	8.3	24.1	99%
TS6	06:10	7.05	7.1	20.7	79%
	14:15	7.9	9.9	25.0	120%
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GPO	7:15	6.7	6.8	20.3	75%
	15:05	7.1	7.5	23.0	87%
WRT	06:55	6.8	6.9	18.6	74%
	14:50	6.9	7.4	21.1	83%
TVA	07:50	-	8.1	21.0	91%
	15:25	-	8.2	21.6	93%

all samples at mid depth

GPO backwatered?

Date:	08/15/02				
Station		pH	DO mg/l	Temp °C	% Sat
TS1W	06:45	6.5	6.5	24.5	78%
	13:28	6.7	6.6	27.3	83%
TS1AC	06:10	6.4	4.8	24.0	57%
	13:40	6.5	6.7	27.4	85%
TS1E	06:07	6.4	2.2	21.1	25%
	13:37	6.3	3.4	23.8	40%
TS2	06:27	6.25	4.0	25.1	48%
	13:51	6.3	5.9	28.0	75%
TS2A cem.	08:12	-	4.2	23.6	50%
	14:05	-	5.5	25.2	67%
TS2B	07:07	6.65	4.8	23.6	57%
	14:11	6.6	7.3	28.0	93%
TS3B	07:24	6.5	4.6	23.5	54%
	14:30	6.6	6.7	26.9	84%
TS4	07:10	6.7	5.4	23.3	63%
	14:05	7.1	6.6	27.6	84%
TS5	06:40	6.9	5.9	23.0	69%
	13:55	7.5	8.0	27.3	101%
TS6	06:20	7.0	6.5	21.7	74%
	13:40	8.6	10	28.0	130%
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GPO	7:45	6.9	5.1	21.6	58%
	14:25	6.8	6.8	26.0	83%
WRT	07:20	6.6	4.2	19.5	46%
	14:10	6.8	5.1	22.5	59%
TVA	08:00	-	7.5	23.5	88%
	-	-	-	-	-

all samples at mid depth

TS1W Stagnant

GPO may be backwatered

Date:	08/27/02				
Station		pH	DO mg/l	Temp °C	% Sat
TS1W	06:37	6.4	7.0	20.7	78%
	13:55	6.9	7.1	23.6	84%
TS1AC	06:06	6.6	5.8	19.9	64%
	14:10	6.7	7.4	23.0	86%
TS1E	06:02	6.65	3.9	16.9	40%
	14:02	6.6	4.2	17.5	44%
TS2	06:20	6.35	4.7	20.2	52%
	14:16	6.5	6.35	23.4	75%
TS2A cem.	07:55	-	5.4	18.6	58%
	14:25	-	6.5	20.3	72%
TS2B	07:05	6.7	5.8	18.5	62%
	14:36	6.9	7.9	23.2	92%
TS3B	07:19	6.5	5.3	18.9	57%
	14:40	6.7	7.3	22.2	84%
TS4	06:50	6.7	6.2	18.3	66%
	14:25	6.9	7.6	22.4	88%
TS5	06:35	6.9	6.7	18.2	71%
	14:14	7.5	9.6	22.2	110%
TS6	06:15	7.1	8.0	16.9	83%
	14:00	8.4	11	24.0	127%
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GPOrev*	7:30 +/-	7.2	6.9	16.9	71%
	14:45	7.0	7.8	21.0	87%

all samples at mid depth

TS1W stagnant

*revised site (upstream, flowing)

Date:	09/26/02			
Station		DO mg/l	Temp °C	% Sat
TS1W	07:17	7.1	17.8	75%
	13:42	7.7	19.9	85%
TS1AC	06:50	5.85	15.8	59%
	13:51	7.2	17.9	76%
TS1E	06:40	5.7	13.1	54%
	13:49	6.8	15.8	69%
TS2	07:00	3.7	16.1	38%
	14:04	5.4	18.0	57%
TS2A cem.	07:35	6.3	15.0	62%
	14:16	7.4	16.2	75%
TS2B	07:43	6.5	14.0	63%
	14:22	8.4	17.1	87%
TS3B	08:00	5.9	15.7	59%
	13:25	7.4	16.9	76%
TS4	07:26	5.9	15.5	59%
	13:45	8.0	18.3	85%
TS5	07:15	6.3	14.9	62%
	13:35	10.3	17.5	108%
TS6	06:50	8.1	13.3	77%
	14:05	14	17.3	145%
<hr/>				
GPOrev	7:58	7.5	13.7	72%
	13:36	9.2	15.6	92%
WRT	07:40	9.1	12.3	85%
	13:52	9.4	14.6	92%
TVA	-	-	-	-
	13:31	8.4	19.5	91%

all samples at mid depth

Chemical Data

Togus Stream, 7/9/02 Survey

Station	Time	E. coli /100 ml	TKN mg/l	NH3 mg/l	NOx mg/l	TP ppb	PO4 ppb	Chl-a, ppb		BOD5* mg/l	BOD5 mg/l	TBOD* mg/l	NBOD mg/l	CBOD* mg/l	final NOx
								uncor***	cor						
TS1AC	5:55	81	0.7	0.03	0.01	28	1	8.4	6.9	-	-	8.0	1.1	6.9	0.26
TS1E	5:45	9	0.8	0.05	0.13	68	19	6.9	5.1	-	-	8.6	1.0	7.7	0.35
TS2B	6:33	120	0.7	0.02	0.04	26	4	2.7	2.4	-	-	8.8	1.0	7.7	0.28
TS3B	6:50	120	0.6	0.02	0.31	84	48	4.9	4.3	-	-	8.7	0.9	7.8	0.52
TS5	7:53 dupe	55 73	0.6 0.7	0.03 0.03	0.23 0.23	79 78	38 38	4.8 4.9	4.5 NA	-	-	8.2 7.7	1.0 0.8	7.2 6.9	0.45 0.42
TVA	comp.**	-	0.2	0.03	21	3500	3500	-	-	1.5	1.1	7.6	0	7.6	19.7

*approximate

**collected 7/10/02

***OD @ 664 nm <0.1 or >1.0

Togus Stream, 7/18/02 Survey

Station	Time	E. coli /100 ml	TKN mg/l	NH3 mg/l	NOx mg/l	TP ppb	PO4 ppb	Chl-a, ppb		BOD5 mg/l	BOD5 mg/l	TBOD* mg/l	NBOD mg/l	CBOD* mg/l	final NOx
								uncor	cor						
TS1AC	6:00	91	0.6	0.02	0.02	29	1	7.4	6.0	-	-	9.8	1.2	8.6	0.29
TS1E	5:50	9	0.7	0.03	0.10	63	15	4.2**	2.4	-	-	10.6	0.7	9.9	0.26
TS2B	6:40 14:45	100 -	0.6 -	0.02 -	0.08 -	35 35	4 -	3.9** 3.1	3.7 -	-	-	8.9 -	0.8 -	8.0 -	0.27
TS3B	7:00 14:15	140 -	0.7 -	0.02 -	0.23 -	78 110	42 -	3.8** 3.1	3.2 -	-	-	8.9 -	0.8 -	8.1 -	0.41
TS5	6:35	64	0.7	0.01	0.25	88	42	3.2**	3.2	-	-	9.0	0.8	8.2	0.44
TS6	6:00 dup	64 27	0.6 0.6	<.01 <.01	0.27 0.27	73 73	27 28	2.6** 2.8**	2.4 2.4	-	-	11.9 7.8	0.6 0.6	11.3 7.2	0.41 0.41
GPO	7:20	9	0.9	0.01	0.07	56	12	2.1**	2.2	-	-	13.2	0.9	12.4	0.27
WRT	7:05 dup	55 <9	0.9 0.9	0.02 0.02	0.14 0.14	42 40	5 5	2.4** 2.4**	2.7 3.2	-	-	9.6 8.9	0.6 1.0	9.0 7.9	0.28 0.37
TVA	comp. dup	- -	1.8 1.7	0.19 0.19	17 17	4200 4200	4000 3900	- -	2.8 2.9	1.4 -	7.2 6.9	0 0	7.2 6.9	14.98 14	

*approximate

**OD @ 664 nm <0.1 or >1.0

Togus Stream, 7/30/02 Survey

Station	Time	E. coli /100 ml	TKN mg/l	NH3 mg/l	NOx mg/l	TP ppb	PO4 ppb	Chl-a, ppb		DEP		STP		final NOx	
								uncor	cor	BOD5 mg/l	BOD5 mg/l	TBOD mg/l	NBOD mg/l	CBOD mg/l	
TS1AC	6:15	130	0.7	0.02	0.03	31	1	7.7	5.2	-	-	9.4	1.1	8.3	0.29
TS1E	6:00	40	0.8	0.05	0.06	70	13	4.8*	2.9	-	-	12.3	1.1	11.2	0.32
TS2B	7:00	170	0.6	0.02	0.1	26	5	3.6*	3.2	-	-	7.0	0.5	6.5	0.22
TS3B	7:30 dupe	130 220	0.9 1.0	0.03 0.02	1.7 1.8	290 310	250 260	3.4* 3.5*	3.2 2.8	-	-	8.6 8.6	0.4 0.4	8.1 8.2	1.8 1.9
TS5	6:30	50	0.6	0.01	0.24	86	37	2.5*	2.7	-	-	8.5	1.1	7.4	0.49
TVA	comp.	-	0.8	0.04	21	3700	3500	-	-	1.2	1.4**	7.4	0	7.38	19

*OD @ 664 nm <0.1 or >1.0

**8/1/02

GPO backwatered?

Togus Stream, 8/15/02 Survey

Station	Time	E. coli /100 ml	TKN mg/l	NH3 mg/l	NOx mg/l	TP ppb	PO4 ppb	Chl-a, ppb		DEP		STP		final NOx	
								uncor*	cor	BOD5 mg/l	BOD5 mg/l	TBOD mg/l	NBOD mg/l	CBOD mg/l	
TS1W	6:45	10	0.6	0.01	0.03	25	<1	5.9	5.9	-	-	7.6	0.7	6.8	0.20
TS1E	6:07	-	-	-	-	-	-	-	-	-	-	11.6	-	-	0.32
TS2	6:27 13:51	40	0.6	0.01	0.02	26 23	1	3.9 3.8	4.5 3.7	-	-	8.5	0.8	7.7	0.20
TS2B	7:07	10	0.6	0.02	0.05	33	5	2.7	3.7	-	-	6.3	0.6	5.7	0.19
TS3B	7:24 14:30	250	0.8	0.04	1.6	330 350	260	3.6 2.2	5.1 2.4	-	-	6.3	0.0	6.3	1.5
TS5	6:40 dupe	10 40	0.6 0.6	0.01 0.01	0.03 0.03	70 69	24 24	2.5 2.0	3.2 2.1	-	-	5.7 7.3	0.5 0.6	5.2 6.7	0.15 0.17
TS6	6:20	20	0.5	<.01	0.01	44	13	1.5	1.6	-	-	4.9	0.4	4.4	0.11
GPO	7:45	60	0.8	0.02	0.15	50	14	2.2	3.5	-	-	10.0	0.6	9.4	0.29
WRT	7:20	-	-	-	-	-	-	-	-	-	-	5.3	-	-	0.31
TVA	comp. dupe	-	1.0 1.1	0.02 0.02	15 15	2900 2800	2600 2600	-	-	1.1 1.1	1.2 -	7.4 5.5	0 0	7.4 5.5	14 14

*OD @ 664 nm <0.1 or >1.0

GPO may be backwatered

Togus Stream, 8/27/02 Survey

Station	Time	E. coli /100 ml	TKN mg/l	NH3 mg/l	NOx mg/l	TP ppb	PO4 ppb	Chl-a, ppb		BOD5 mg/l	BOD5 mg/l	TBOD mg/l	NBOD mg/l	CBOD mg/l	final NOx
								uncor***	cor						
TS1W	6:37 dupe	50 20	0.5 0.5	0.01 0.01	0.04 0.04	21 21	<1 1	6.7 6.2	6.9 6.1	- -	- -	6.2 6.3	0.6 0.6	5.6 5.7	0.18 0.18
TS1E	6:02	-	-	-	-	-	-	-	-	-	-	10.2	-	-	0.28
TS2	6:20	<10	0.5	0.02	0.05	20	3	3.3	3.8	-	-	5.8	0.5	5.3	0.17
TS2B	7:05	40	0.5	0.01	0.02	27	2	3.2	4.5	-	-	4.9	0.8	4.1	0.20
TS3B	7:19	210	0.8	0.03	2.1	490	450	4.1	4.3	-	-	5.3	0.0	5.3	2.1
TS4	6:50	-	-	-	-	-	-	-	-	-	-	5.7	-	-	0.32
TS5	6:35	<10	0.5	<.01	0.1	87	39	2.7	3.5	-	-	5.5	0.5	5.0	0.21
TS6	6:15	-	-	-	-	-	-	-	-	-	-	5.0	-	-	0.17
GPOrev**	7:30* 11:45	- 10	- 0.7	- 0.01	- 0.12	- 40	- 12	- 1.6	- 2.1	-	-	9.0	-	-	0.22
TVA	comp.	-	1.2	0.05	18	4100	3900	-	-	0.5	1.4#	7.5	0	7.5	17

*approx.

**moved upstream from previous site

***OD @ 664 nm <0.1 or >1.0

#8/26/02

Togus Stream, 9/26/02 Survey

Station	Time	E. coli /100 ml	TKN mg/l	NH3 mg/l	NOx mg/l	TP ppb	PO4 ppb	Chl-a, ppb		BOD5 mg/l	BOD5 mg/l	TBOD mg/l	NBOD mg/l	CBOD mg/l	final NOx
								uncor*	cor						
TS1W	7:17	<10	0.5	0.01	0.06	20	3	4.5	4.0	-	-	5.2	0.5	4.7	0.18
TS1E	6:40	80	0.8	0.04	0.14	57	14	4.5	2.4	-	-	10.7	0.6	10.1	0.27
TS2	7:00	10	0.6	0.03	0.04	28	2	4.3	3.2	-	-	7.4	0.7	6.6	0.21
TS2B	7:43	70	0.5	0.03	0.09	27	4	3.1	2.9	-	-	3.7	0.5	3.3	0.20
TS3B	9:00	600	1.0	0.05	3.7	560	480	2.7	4.8	-	-	5.3	0.0	5.3	3.5
TS5	7:15	20	0.6	0.02	0.45	120	77	4.6	3.7	-	-	4.2	0.5	3.7	0.56
TS6	6:50	<10	0.4	<.01	0.01	36	8	3.1	3.5	-	-	4.8	0.3	4.5	0.09
GPOrev	7:58 dupe	<10 NA	0.6 0.6	0.01 0.01	0.18 0.18	36 36	11 11	1.9 4.0	2.7 3.7	-	-	4.8 5.6	0.3 0.3	4.5 5.3	0.26 0.26
WRT	7:40	30	0.6	<.01	0.05	30	3	3.2	4.0	-	-	3.9	0.3	3.6	0.12
TVA	comp.	-	0.9	0.08	17	2500	2300	-	-	1.7	1.7	8.7	0.0	8.7	15

*OD @ 664 nm <0.1 or >1.0

2002 Survey Weather Conditions

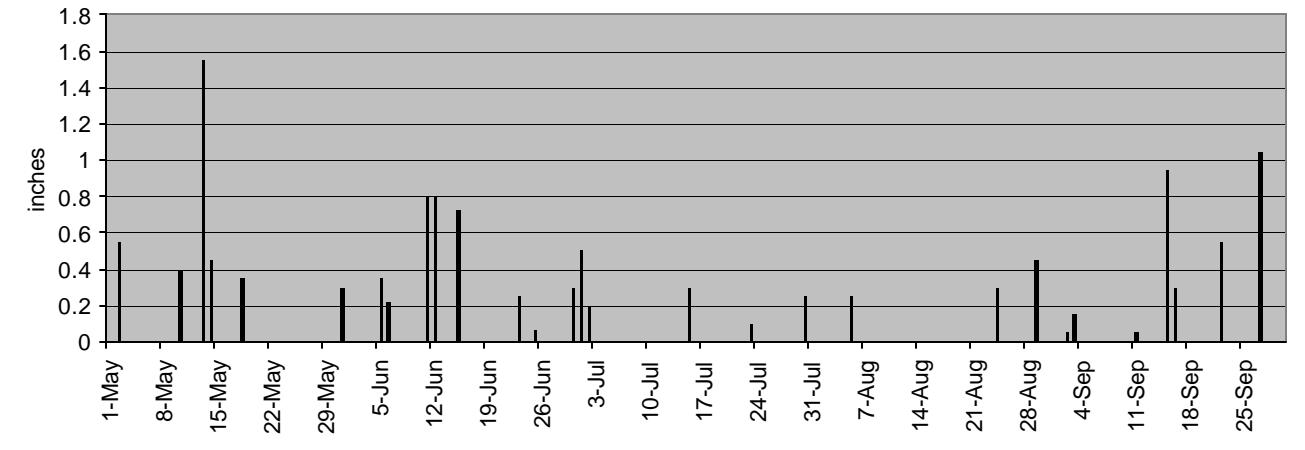
	Sample Date					
	7/9/02	7/18/02	7/30/02	8/15/02	8/27/02	9/25/02
Cloud cover	overcast w/ showers then breaks	clear then mostly cloudy/hazy	clear except showers mid day	clear to hazy	clear	partly cloudy to overcast
Precipitation*, in.	0.05	0.03	0.51	0	0	.04**
Temp, F	80-64	77-59	88-65	96-69	83-59	74-50
Dew Point, F	(87% humidity)	67	71-->55	68-69	46-50	48-49
Pressure, in.	29.8	29.8	29.7	30.0-30.1	30.1-30.4	30.3

Range of values within the period +/- 24 hours of sample day

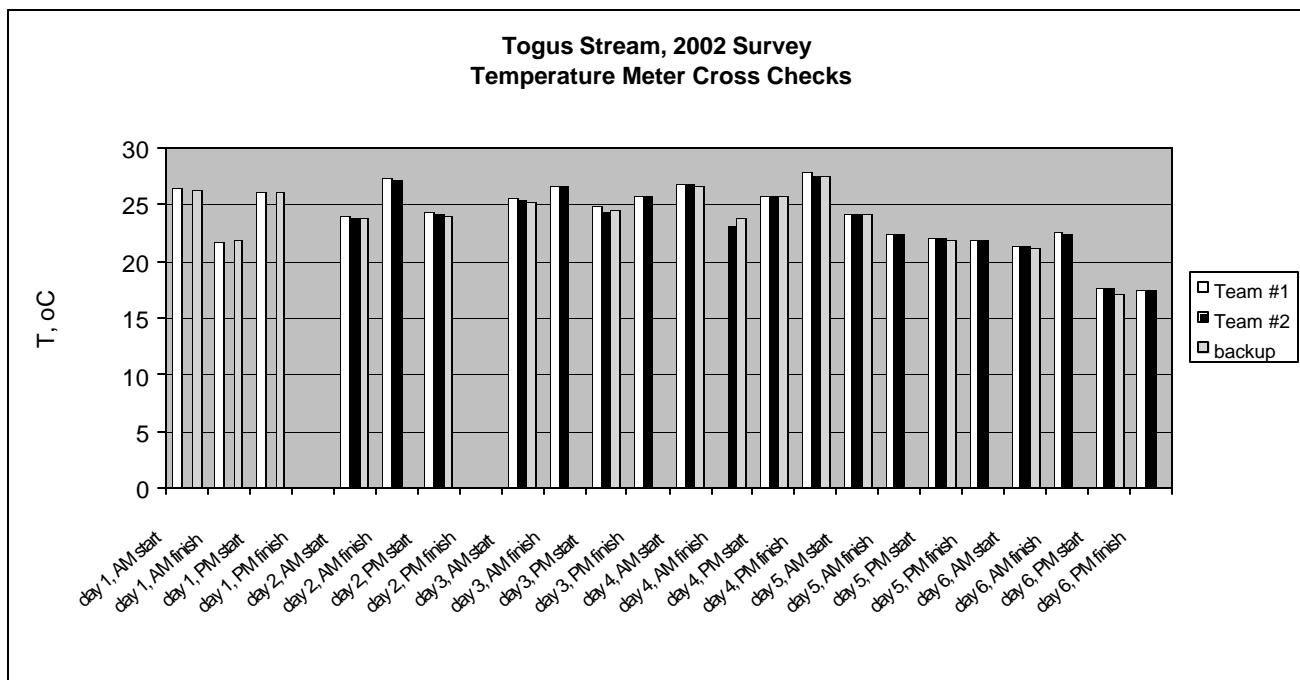
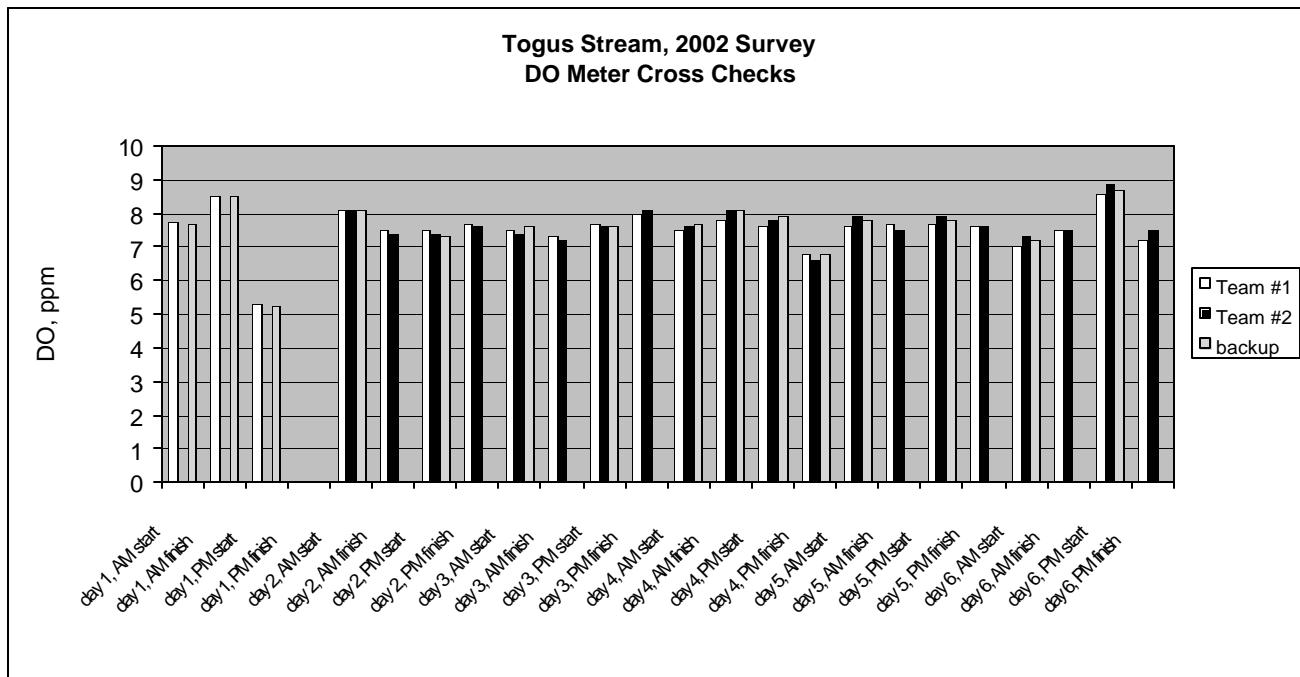
*Augusta

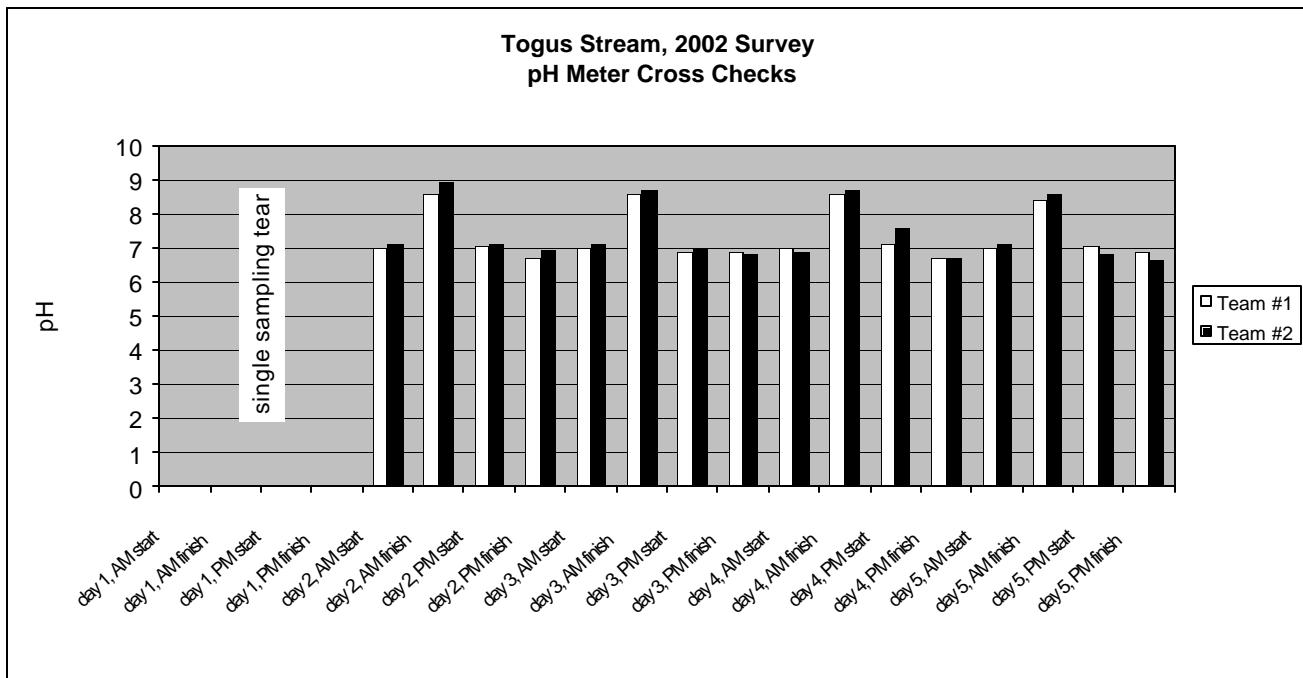
**.69 two days prior

2002 Precipitation at Togus VA

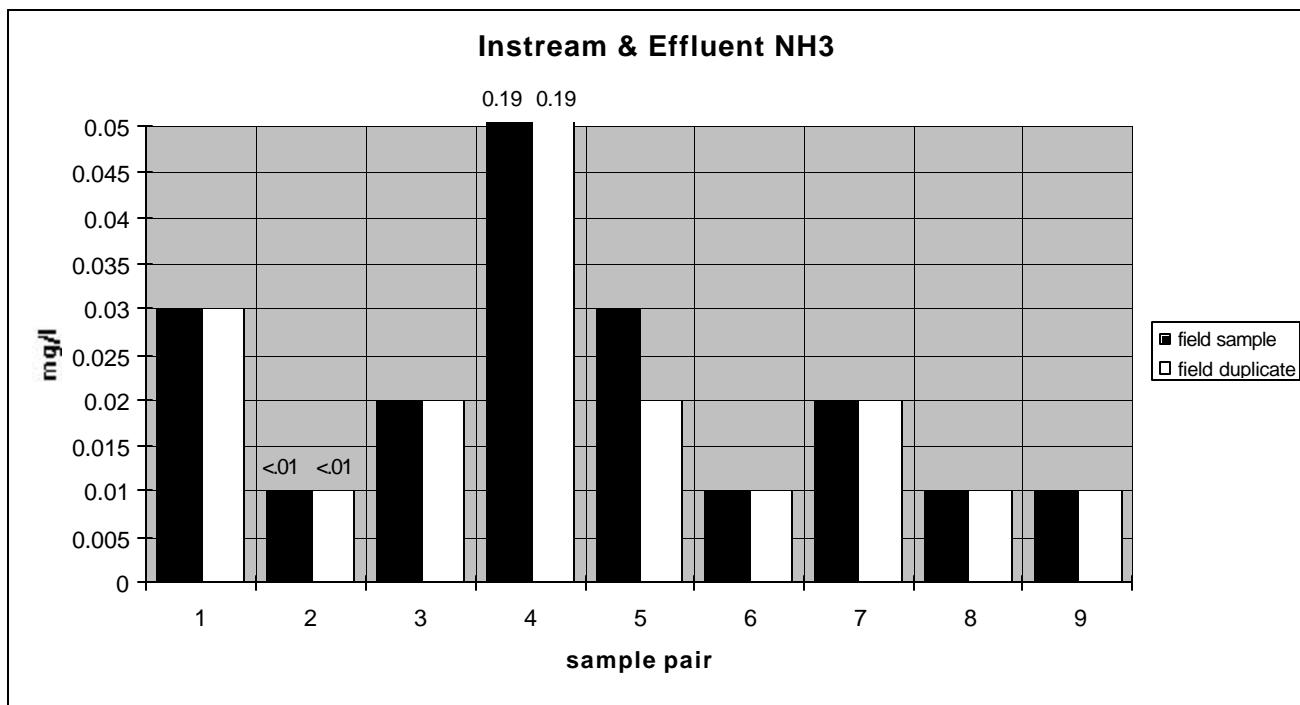
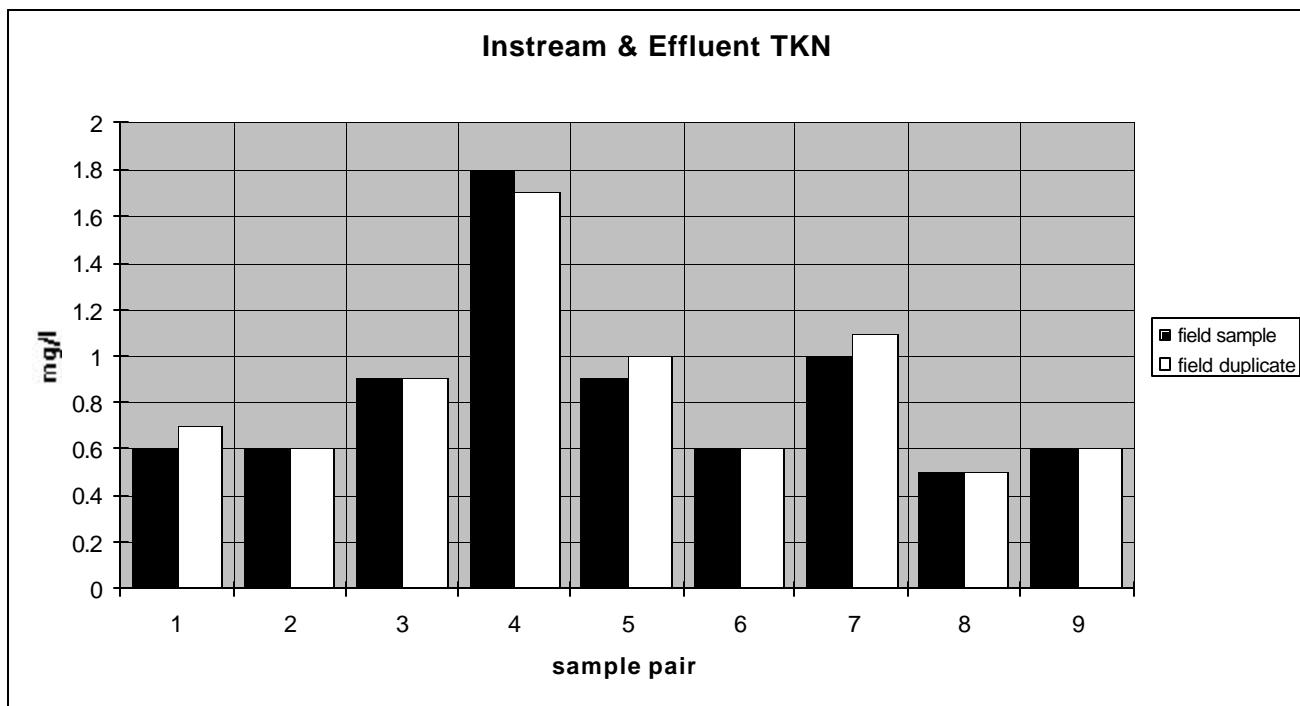


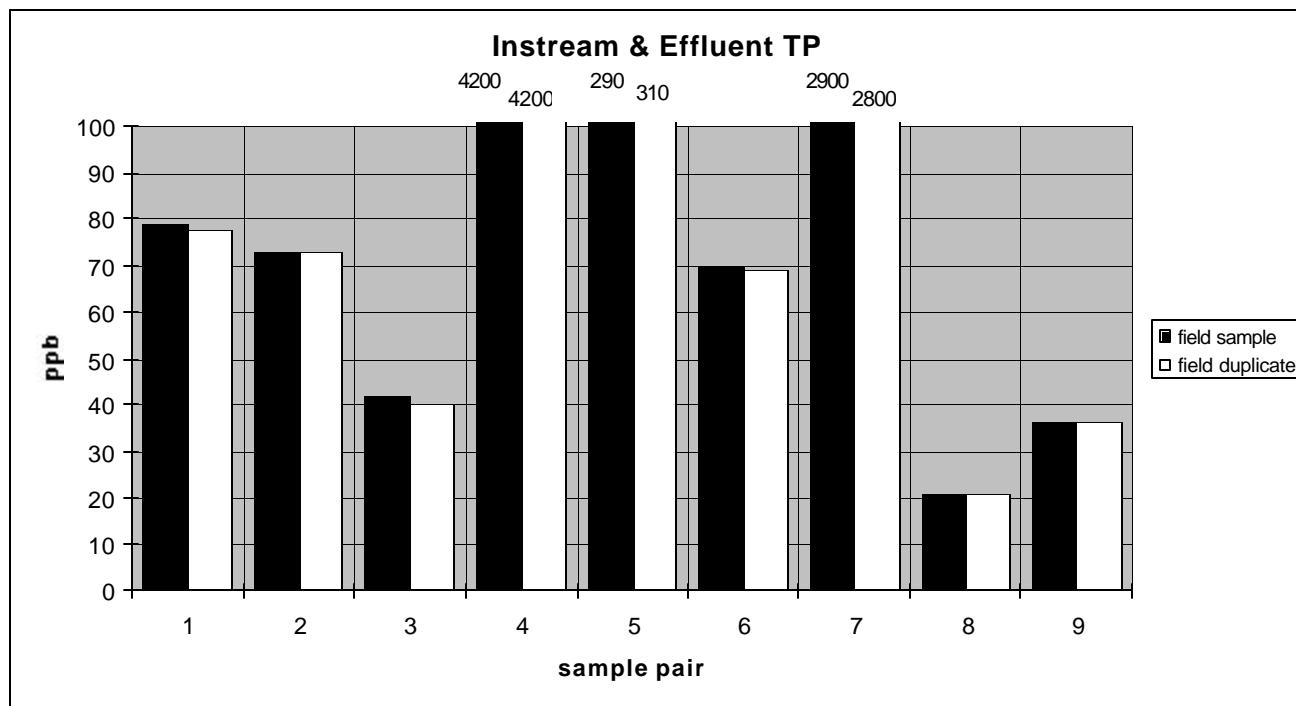
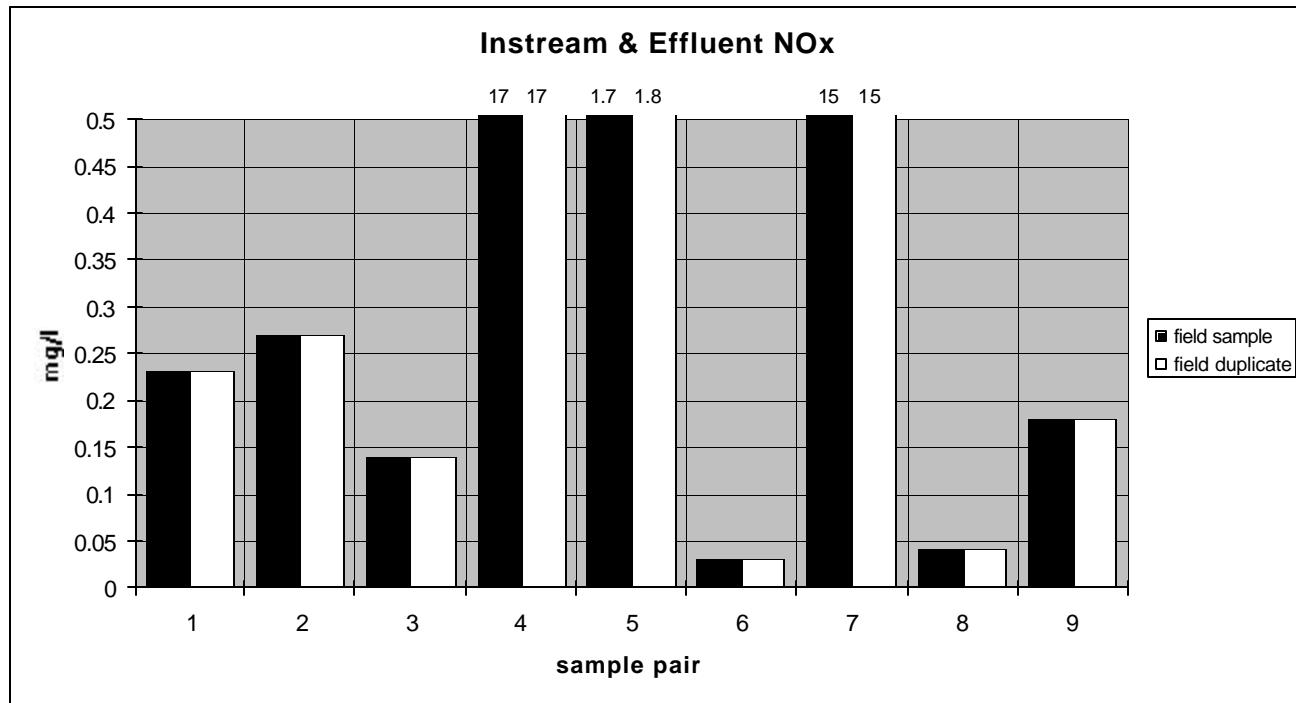
Meter Cross Checks, 2002 Togus Stream Survey

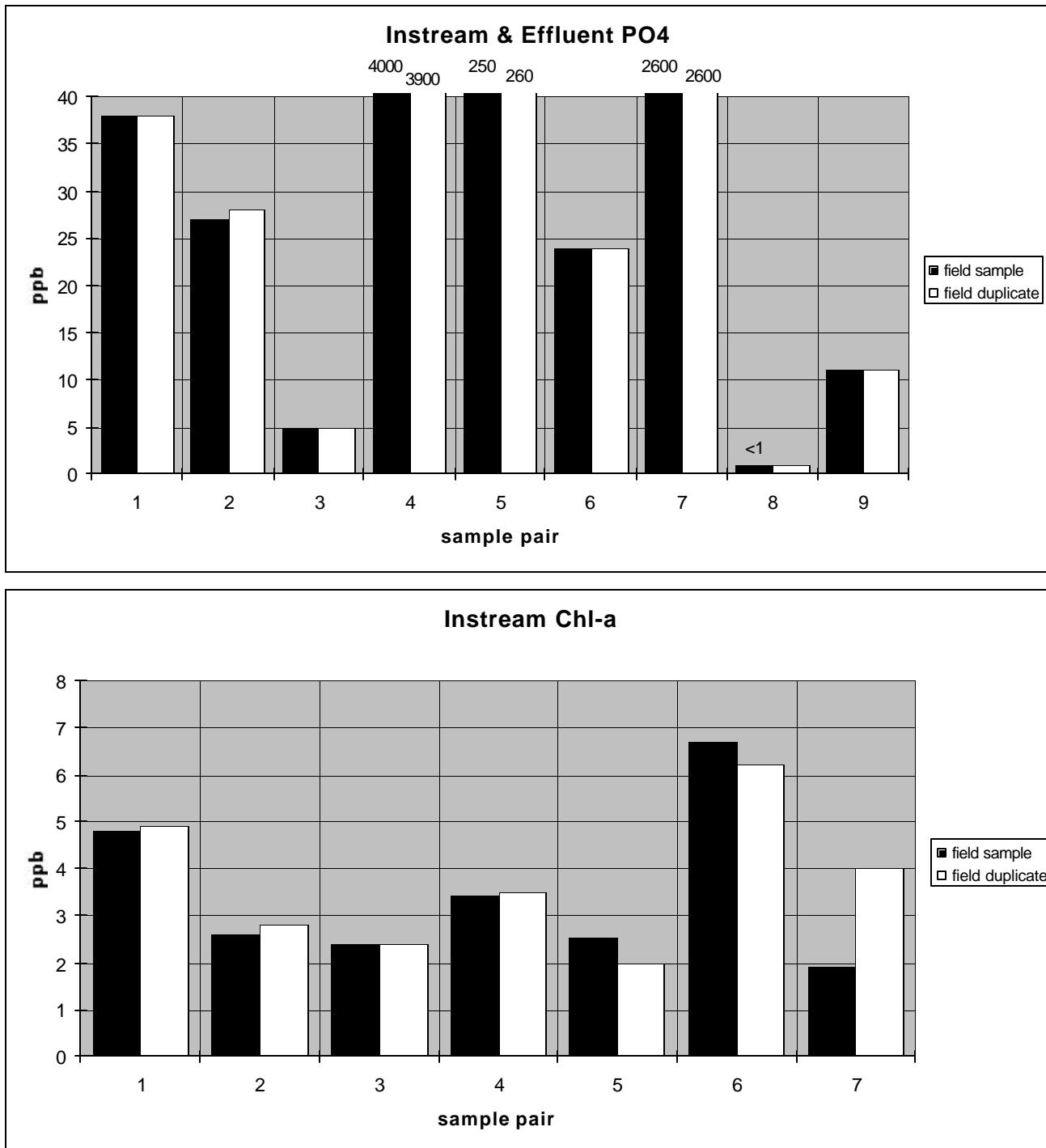


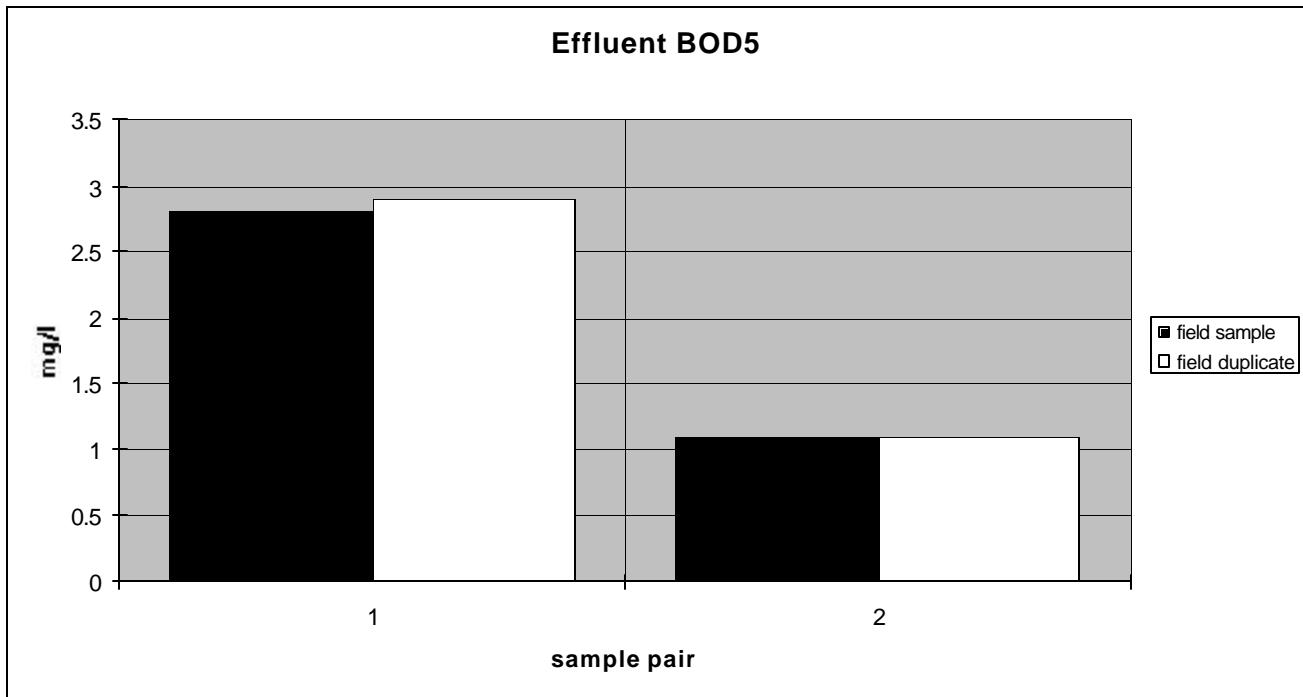
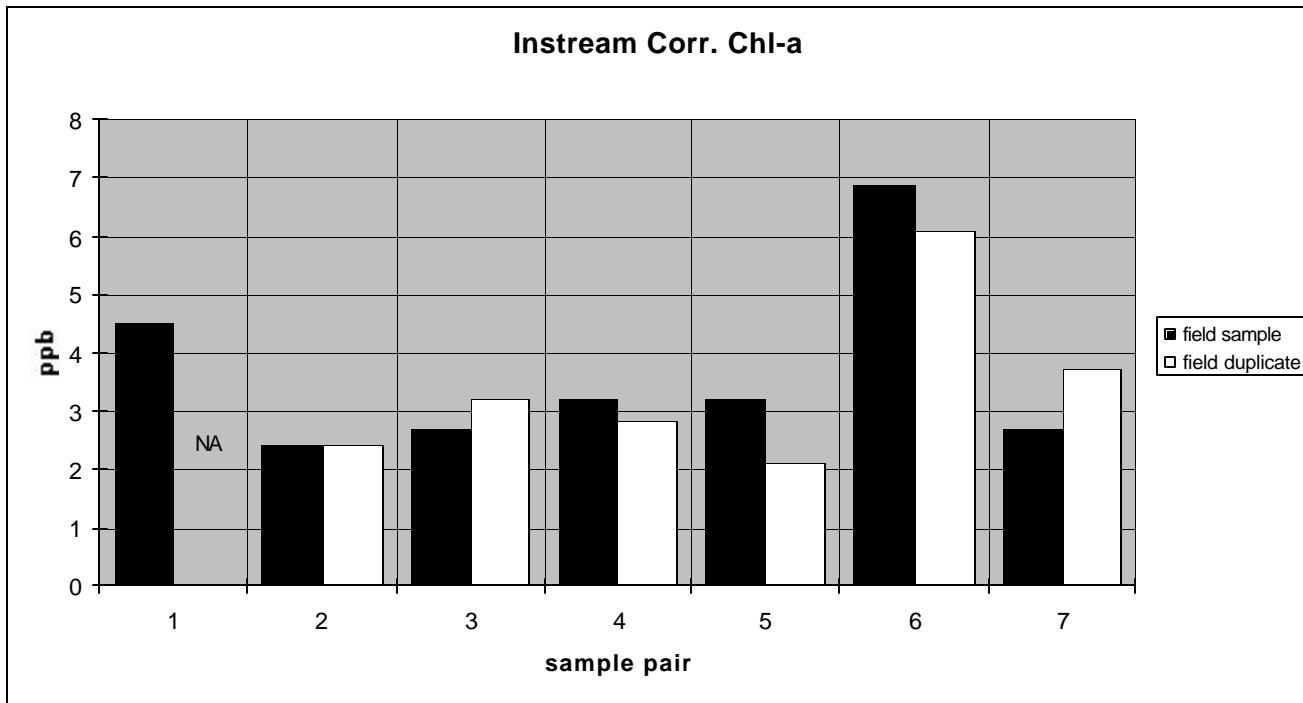


Field Duplicate Sample Comparisons

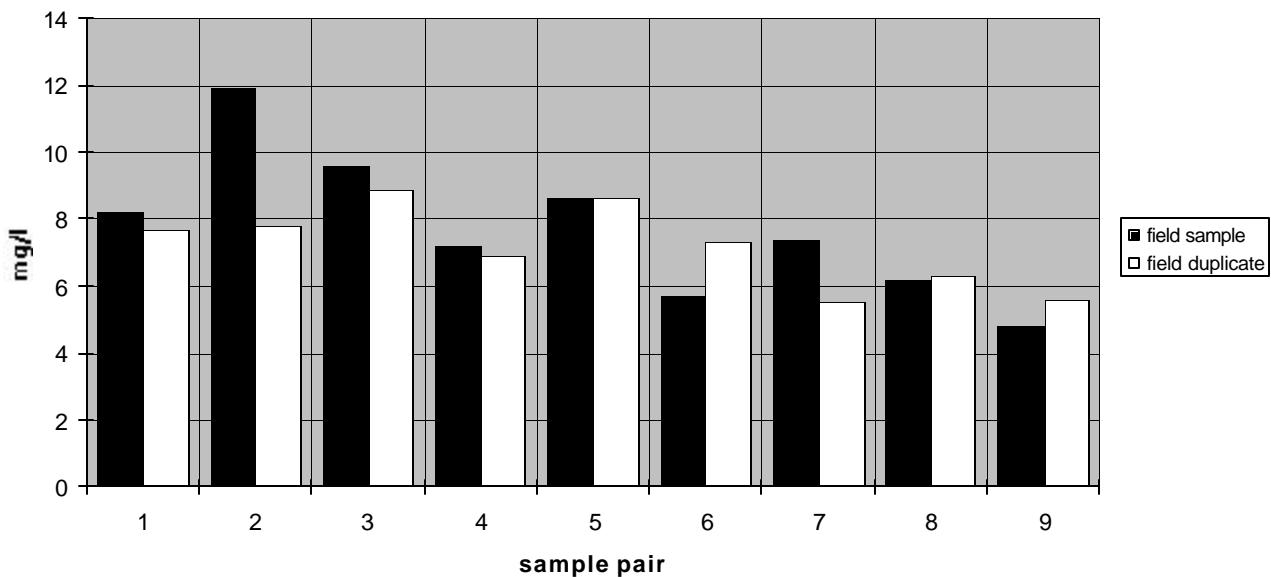




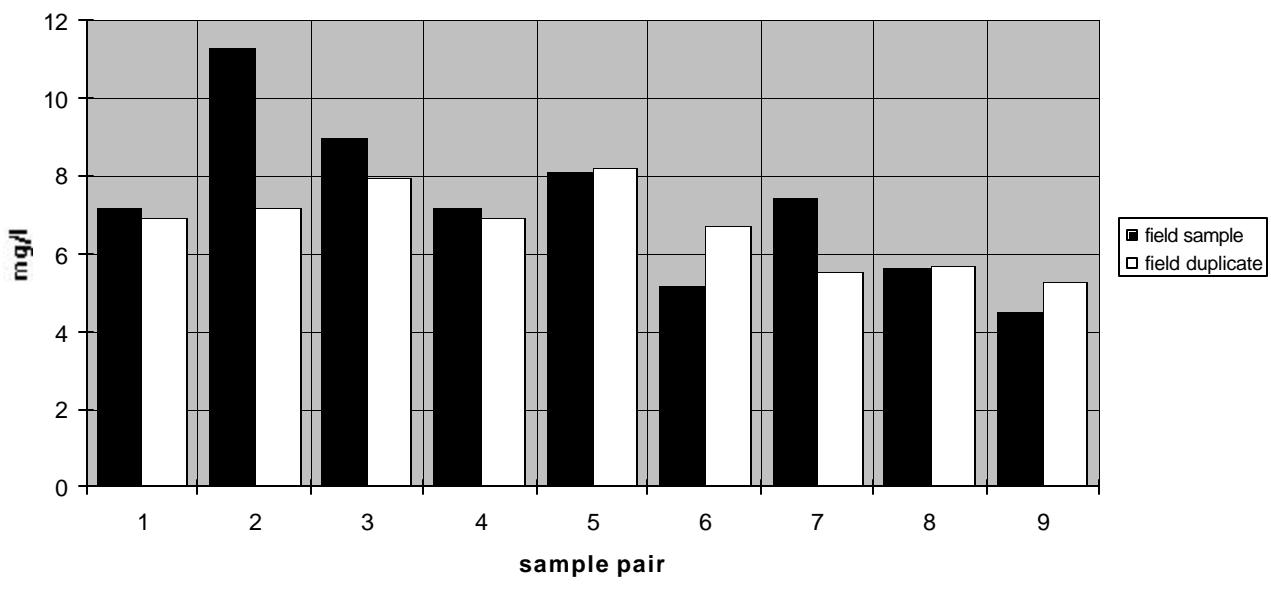


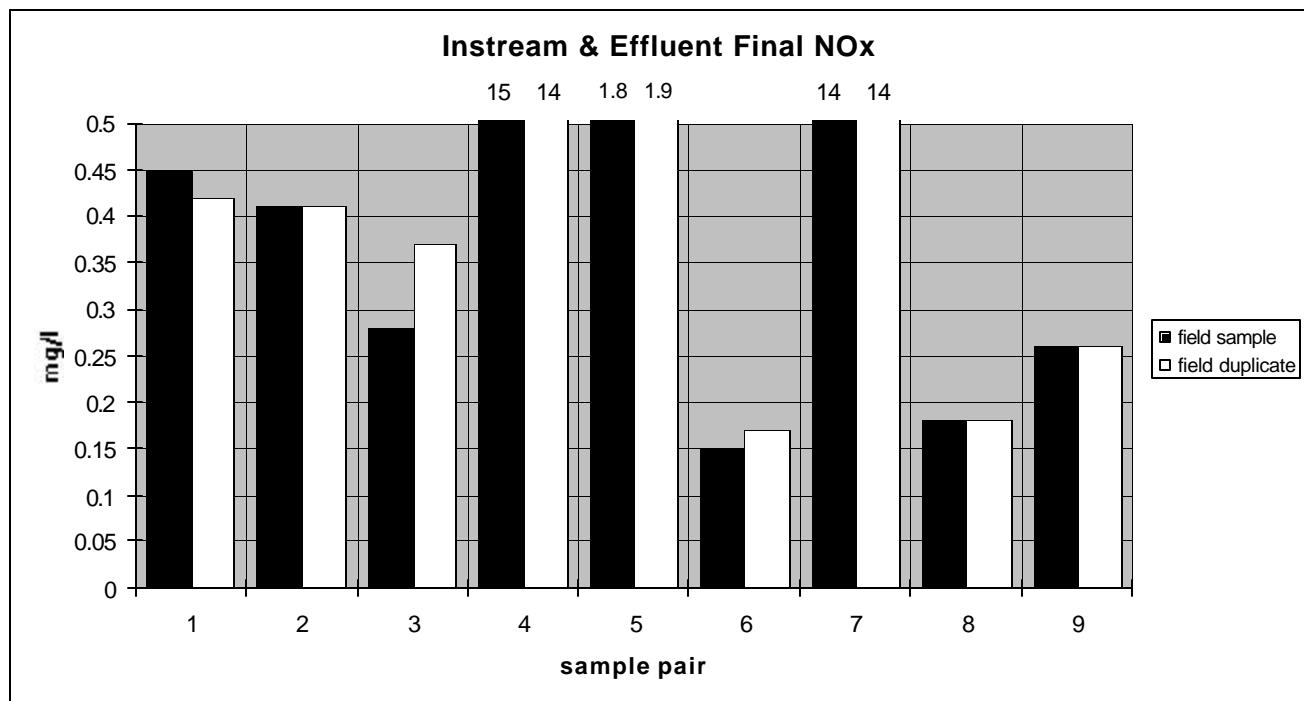
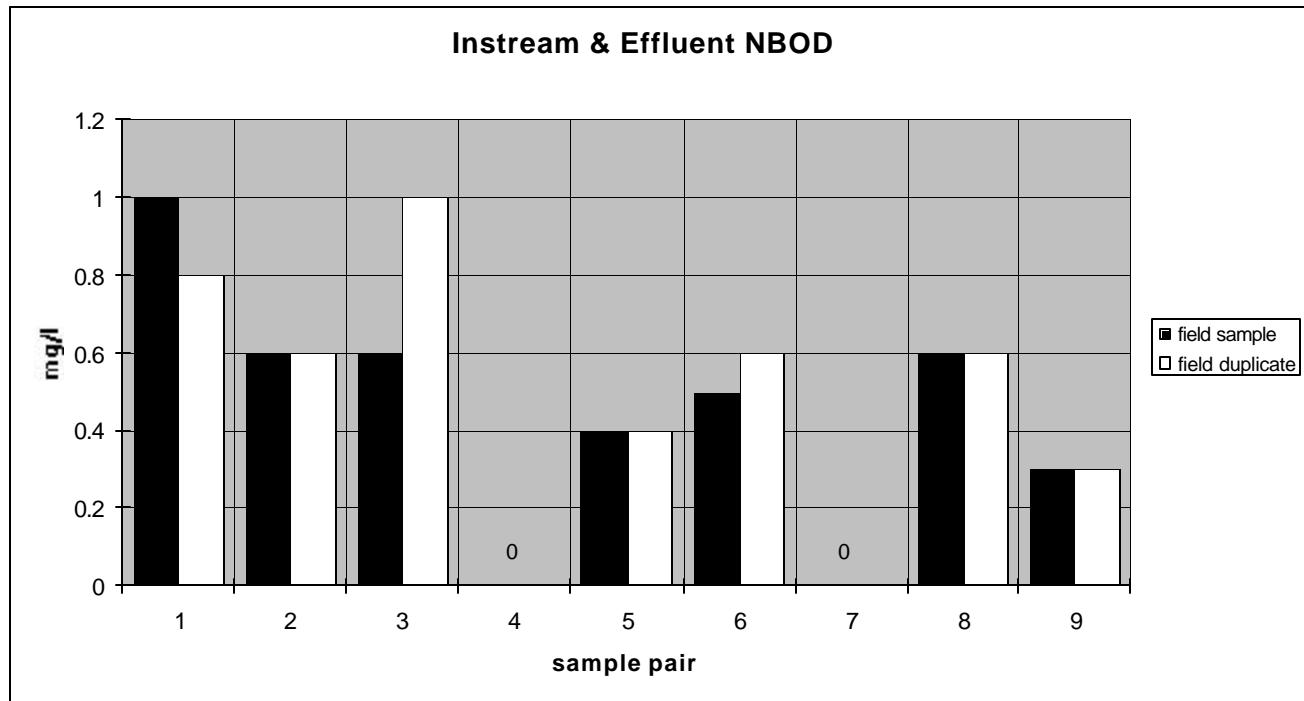


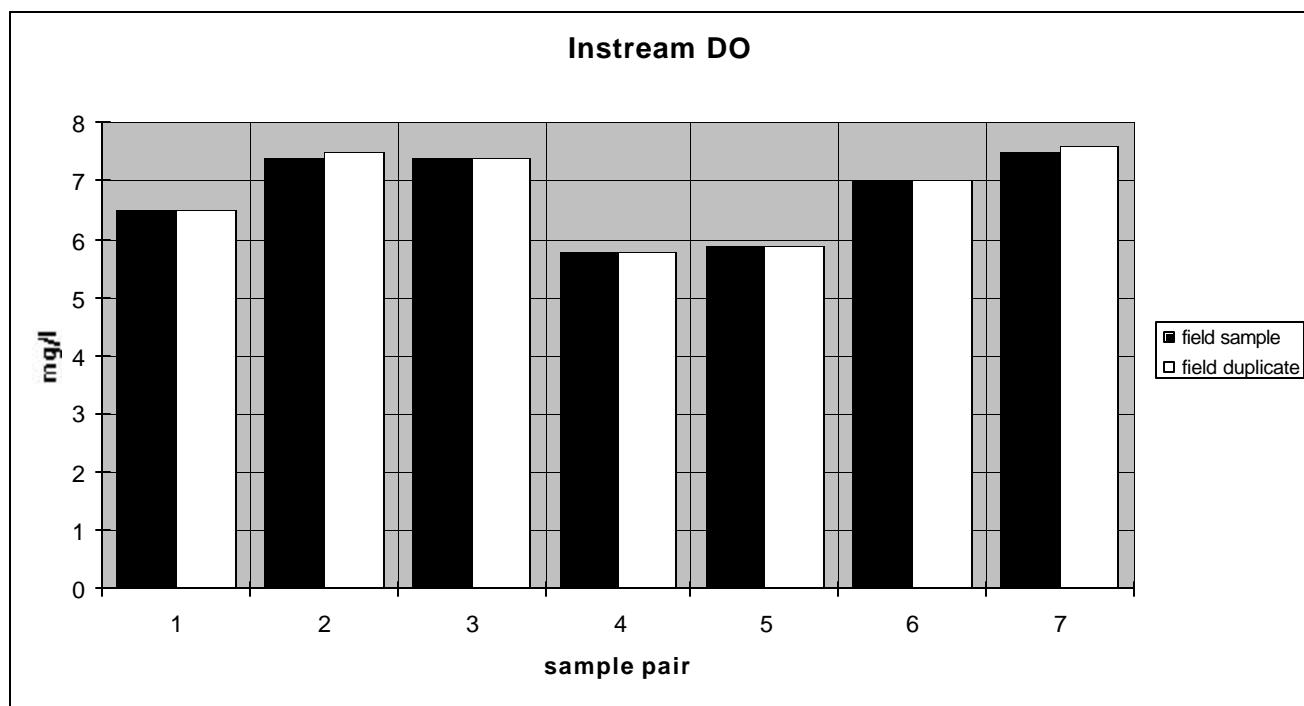
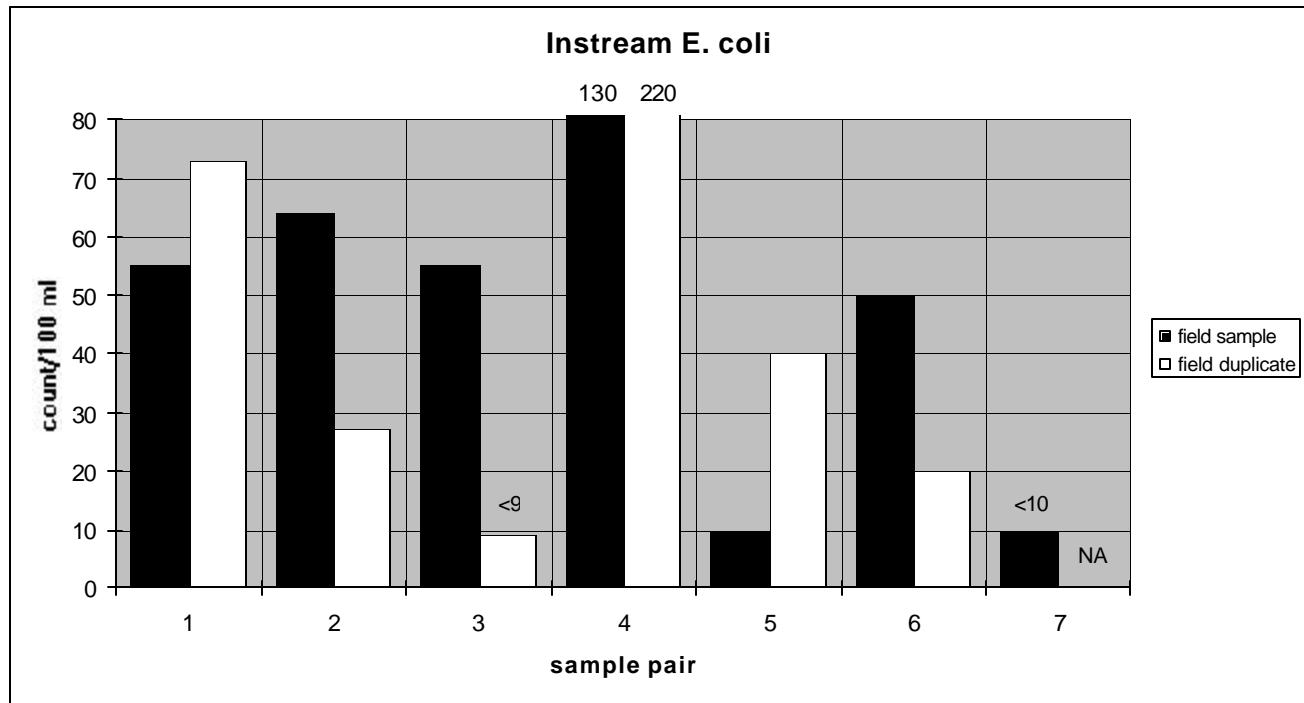
Instream & Effluent TBOD

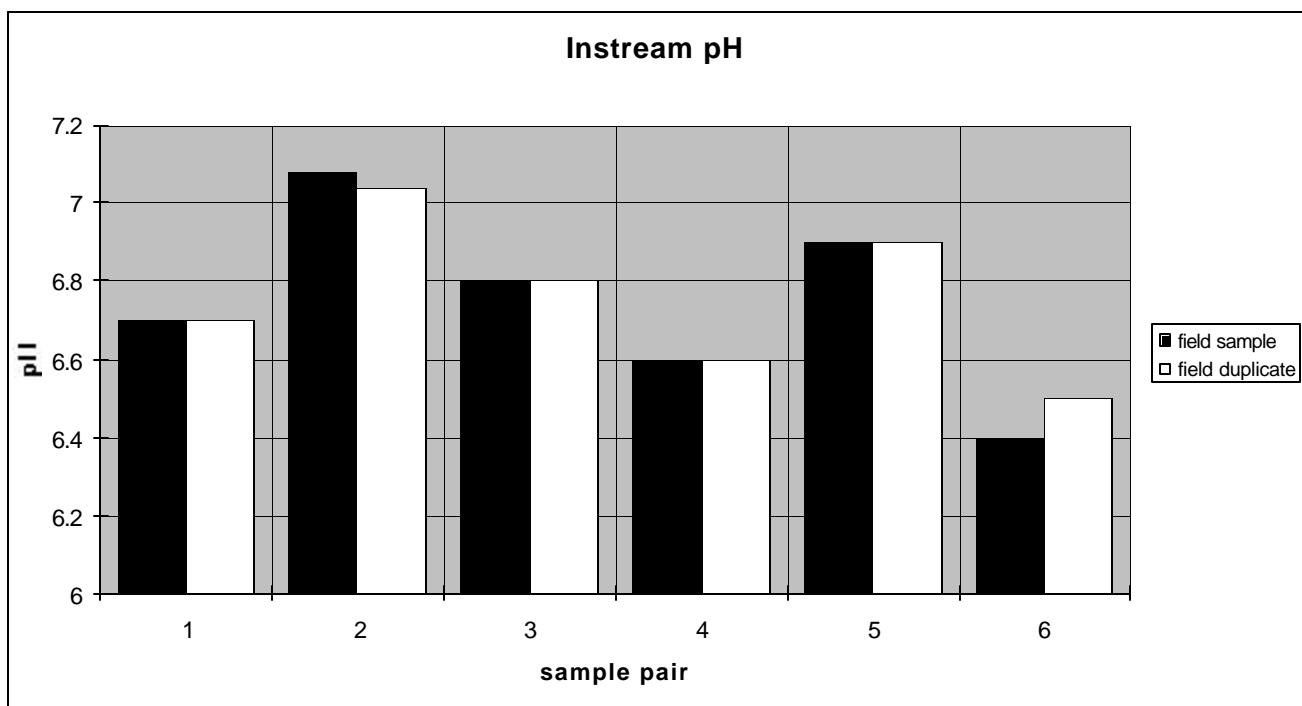
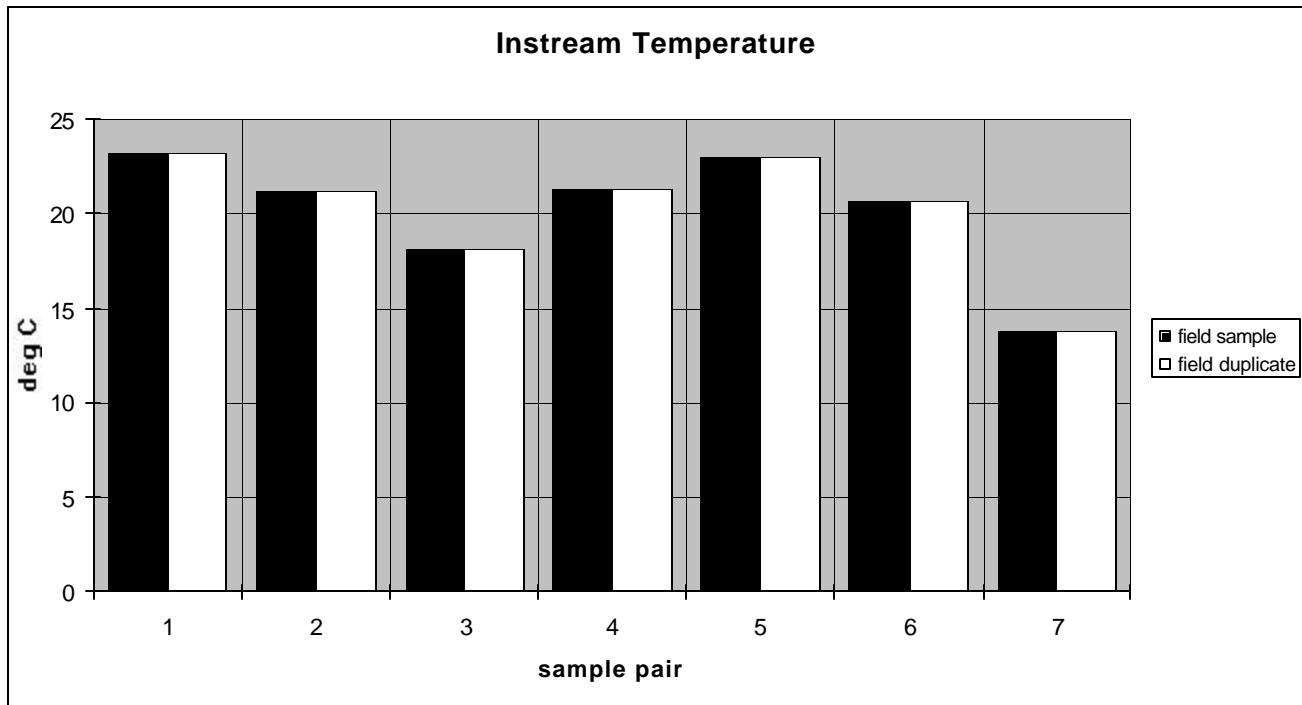


Instream & Effluent CBOD









Togus Stream Periphyton Study 2002

			Chl A	Chl A corr	Chl A	TP	PO4	TKN	NOx	Width	Depth	Velocity	Measured	Temp	SpecCond	DO			
Location	Sample	Date	mg/m^2	mg/m^2	substrate	ppm	ppm	ppm	ppm	m	cm	cm/s	Estimated	°C	uS	ppm	pH	Color	Alkalinity
TS3E	SA-611-2002	7/15/2002	12.56	8.73	slides	0.14	0.097	0.7	0.67	5	33	26.3	measured	22.6	67	6.6	6.66	55	13
TS3E	SA-611-2002	7/1/2002									36	35	measured	21.6	76	6.9	6.95		
TS2E	SA-610-2002	7/15/2002	12.92	11.33	slides	0.031	0.004	0.5	0.07		62	13.2	measured	23.1	40	5.7	6.29	48	10
TS2E	SA-610-2002	7/1/2002									55	26.6	measured	26.2	46	6	6.96		
TS6	SA-612-2002	7/1/2002									26	37.1	measured	22.1	64	7.7	6.96		
TS6	SA-612-2002	7/15/2002	13.2	11.91	slides	0.077	0.021	0.6	0.15		28	16.7	measured	22.5	51	8.1	6.98	48	14

Photographs (9/26/02)



Outlet dam



Outlet dam spillway



Outlet dam - minimum flow pipe?



Wetland above site TS2 (looking upstream)



Looking downstream at Camp above TS2 (seasonal?)



Looking downstream at Site TS2 (Wellman Road culvert)



Below Wellman Rd.